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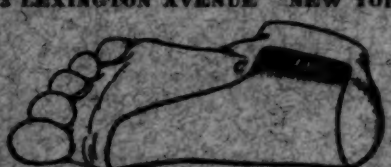

Shows the under surface of the brace and the outer flange. B—The calcaneocuboid articulation. C—The extremity of the fifth metatarsal bone.

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The Journal of Orthopædic Surgery

OSTEOCHONDRITIS OF THE UPPER EXTREMITY OF THE FEMUR.

BY DR. JAQUES CALVÉ, BERCK-PLAGE, FRANCE.

This affection is not clearly individualized except in the radiographic findings. With its etiology disputed and its pathogenesis obscure, its clinical manifestations are poorly defined and its evolution almost entirely unknown. Most of the observations published are incomplete and show only one of the phases—some one particular moment—of the affection. This lack of information results, first, because osteochondritis is a rare condition, and more especially because it is found particularly among hospital patients who are easily lost sight of.

Two cases which I had the good fortune to observe are herewith presented. They synthetize—in my opinion—all the other rare cases scattered throughout medical literature. Their analysis brings a little order into the confusion surrounding this condition and affords some new conclusions.

The first observation is that of a child of three and a half years, of the well-to-do class, who in September, 1915, during the course of a chicken pox suffered slightly with pain in the right hip. Radiographs of the hip were taken, although the pain disappeared almost immediately. The x-ray plates revealed a normal hip. The child recovered from the varicella and resumed her normal life. With the exception of an occasional slight defect in walking from time to time, nothing drew attention to the right hip until the end of 1916,

more than a year later, when the child began to limp and complain of pain in the knee. Examination showed limitation of the movements of the hip; the diagnosis of coxalgia was given. The child was put to bed and treatment by immobilization begun. A radiograph revealed lesions characteristic of osteochondritis; the femoral head was in place, the clear articular space enlarged, the epiphyseal nucleus modified both in form and substance; it was flattened and fragmented.

When I saw the child for the first time in 1918, I discarded the diagnosis of coxalgia and gave a diagnosis of osteochondritis. A radiograph taken at this time showed that the epiphyseal nucleus had augmented in volume and now formed a single round cap-shaped mass. Two and one-half years later, in 1921, a further radiograph showed the epiphyseal nucleus of still greater volume, and of a more regular form, tending to approach the normal. Since 1918, the child has walked without fatigue and has had a normal life.

From this observation, we can deduce that, (1) osteochondritis is not a congenital affection; (2) that the phase of the invasion of the epiphyseal nucleus is latent from the clinical viewpoint; (3) that the clinical phase corresponding to the period when the child first begins to complain of pain is considerably later than the real beginning of the trouble; (4) that to the beginning of the clinical phase there is a corresponding radiographic picture showing an established and characteristic lesion—a laminated and fragmented epiphysis; (5) that the regeneration of the osseous epiphyseal nucleus occurs progressively, as the osseous fragments augment in volume, approach each other, reunite one by one, and finally form a single mass. This regeneration continues through the following years and tends to a return to the normal form.

I have formerly described this regeneration of the osseous nucleus in my first publication in 1910; this regeneration is constant in all the observations if one takes the trouble to look for it. Equally constant is the astonishing variance between the radiographic findings and the first clinical manifestations. This variance, which seems to have been unnoticed until now, proves indisputably that the debut of the trouble, whatever its cause—infectious as in the preceding observation, traumatic, or specific—is clinically silent.

In the second case, that of an English child at Queen Mary's Hospital at Carshalton, all of the interest lies in the examination of the different radiographs made from year to year.

In the first, one can determine an entire absence of the epiphyseal osseous nucleus which one sees regenerate itself at first fragmentarily,

and then in the following radiograph, into a single mass. The important fact of this observation is to show that the destruction of the epiphyseal osseous nucleus may be total and that notwithstanding this, regeneration takes place and finally results in a voluminous epiphyseal nucleus. As regards the clinical history, that of the second child was not noticeably different from that of the first.

These two observations, it seems to me, permit us to look at osteochondritis in a new light. It is a cyclic disease which commences in a healthy child in the first years of life, continues its development, and finishes its course, but leaves after it an acquired malformation, a deformed articulation. The clinical signs do not show themselves during what may be called the inflammatory period of the affection. If they exist, they are slight and pass unperceived; it is only when the femoral head has become deformed in the course of regeneration that the painful phenomena become evident. They are comparable to those which recur from time to time in all articular malformations. They do not arise from an arthritis, but rather from a functional strain. The femoral head, flattened and enlarged, does not adapt itself easily to the cotyloid cavity with which it articulates; the head is, as it were, too large for too small a hat, and it is this fault of adaptation which causes the pain.

To the generally accepted theory which sees active inflammatory lesions in infantile osteochondritis, is opposed this theory of mine of an acquired malformation. The succession of events is something like this: under the influence of infection or traumatism, in a young child in whom the femoral epiphysis possesses a thick cartilaginous shell, the epiphyseal nucleus is partially or totally destroyed,—suppressed—without injury to the neighboring articulation, which is protected by the thickness of the epiphyseal cartilaginous shell. Then the osseous nucleus begins to reform, at first fragmentarily, in irregular and not typical fashion, provoking a more or less accentuated deformation of the cartilaginous epiphysis. This latter, probably under the action of the weight of the body, subsides lightly upon itself, from whence comes the enlargement and flattening characteristic of the affection.

CONCLUSIONS.

The term "osteochondritis" appears defective, for it seems to indicate an affection in full inflammatory evolution. I prefer to substitute for it the term "coxa-plana" proposed by Waldenstorm; it is short and makes clear the fact that the characteristic of the disease

is an acquired articular malformation characterized by the flattening of the superior femoral epiphysis and the regeneration of the epiphyseal osseous nucleus; the articular contacts take place in defective fashion and frequently bring about, under the influence of fatigue or a spurt of growth, painful phenomena comparable to those of all articular malformations. These conclusions have not merely a theoretical interest. It is easy, however, without insisting too much upon them, to deduce from them the matter of practical interest, the *treatment* of the condition.

Historical.

If we eliminate the juvenile arthritis deformans of the old German writers (Hoffa, Zezas, Bruns, and Perthes, before 1910), which is a different disease attacking the articular surfaces which it partially destroys, and on the other hand, bordering on the formation of osteophytes, the two papers which first present the subject of osteochondritis are those written by Legg and by myself, in 1910.

Legg published, February, 1910, the text of a communication made by him in 1909 at the Congress in Hartford.

I published, July, 1910, the observations already recorded in Sourdat's Paris thesis, July, 1909. I emphasize this phrase of Sourdat's: "The discussion of these chronic arthrites will be renewed constantly by Dr. Calvé, whom I thank for permitting me to publish here these observations and these radiographs."

DICUSSSION OF DR. CALVÉ'S PAPER

DR. FRED H. ALBEE, New York City: I do not believe that I can add much to the discussion of this paper by Dr. Calvé. I do, however, wish personally to thank him for the original work which he has done on this disease, and for making this journey here to present his work. I have not had the opportunity to see very many of these cases, but I have been impressed with the fact of its not being necessary to carry out very rigorous treatment. Many of the cases hardly need immobilization, but those with spastic muscles do need immobilization and support for a varying time.

I was much interested in the cases that Dr. Calvé demonstrated. The first case was especially interesting, and I wish again to thank him for his paper.

DR. F. J. GAENSLEN, Milwaukee, Wis.: I think we are very fortunate indeed to have Dr. Calvé here today to tell us of his further studies concerning this interesting condition. I visited him in 1912 when he showed me some of these cases, and ever since that time I have been on the alert for them. I also had occasion to revise the diagnosis on some older cases which I had regarded as so-called quiet hip disease. While most of these cases are very characteristic both as to clinical and x-ray findings, there are some which are not so readily recognized. I recall one in which the symptoms were very acute and in which the limitation of motion was not merely in abduction, but more or less general. The x-ray showed a lesion in the neck as well as in the hip. I could not definitely exclude tuberculosis

and, since the joint still seemed not directly involved, I decided to operate. I have slides of tissue removed which I shall be glad to show.

DR. OSGOOD: Thank you. Will you please show the slides?

DR. GAENSLEN: Dr. Calvé's case is most interesting because he had the opportunity of observing it so long before the characteristic symptoms came on. It is probably the only observation of the kind made. In my own case, the pathologist, Dr. Thalhimer, concluded from exclusions that there might be imperfect osteogenesis. That theory would not be quite in accord with the findings of Dr. Calvé, in that he found the epiphysis normal fully a year before the radiograph showed the characteristic changes.

DR. OSGOOD: Is Dr. Legg here? I am sorry, gentlemen, that you have not the opportunity of hearing from the author of the disease.

(Dr. Gaenslen showed his slides)

DR. GAENSLEN: In this first slide there is seen a fairly normal arrangement of the cartilage cells in rows with normal epiphyseal line formation. I assume this to be on the shaft side of the epiphysis.

In the second slide the opposite side of the epiphysis is shown, presumably that toward the head. Here cartilage cells are disposed very irregularly, often forming irregular columns, and there is also imperfect bone formation. Here there is no regular epiphyseal line formation.

In my own case, cultures made at the time of operation showed no growth. In a case recently reported by Phemister cultures were also negative. These two observations will throw some doubt on the findings of other observers who found staphylococci present.

DR. EDWIN W. RYERSON, Chicago: It seems to me that there may be two causes: one, traumatic; and the other, infectious, as Dr. Calvé once suggested. An x-ray picture that I have here seems so characteristic of an infection that I should like to pass it around. The medial third of the neck of the femur seems to be softened, as though by disease, and the head itself shows the characteristic flattening seen in the typical Legg-Calvé disease. I should like Dr. Calvé's opinion about this picture. It is a case that has been going on for six months. It seems to me very much like an infectious process. As the disease has progressed, the appearance of softening in the neck of the femur has gradually decreased. The neck is now almost normal, but the head is very flat.

DR. JOHN RIDLON, Chicago: If I got the drift of Dr. Calvé's paper, it seems to me that his conclusion should be that we cannot make the diagnosis until the case is entirely finished. If it is true, that we cannot make a diagnosis until the case is finished and we have the entire series of x-ray pictures, and if we cannot make a tentative diagnosis, assuming that we have a case with acute inflammatory symptoms and the typical picture of flattened head and broken up head, what is the diagnosis and treatment if a tubercular abscess develops, as it has developed in two cases of mine?

DR. OSGOOD: Will Dr. Calvé answer the questions? One was in relation to treatment. Have you a treatment to suggest?

DR. CALVÉ: Only rest, but not for so long as is generally ordered.

DR. OSGOOD: And in relation to Dr. Ridlon's question, do you think that it is sometimes easy to mistake this for early tuberculosis of the hip?

DR. CALVÉ: I do not think so.

DR. OSGOOD: Is is usually fairly easy to diagnosis it early?

DR. CALVÉ: I think so.

AN OPERATION FOR STABILIZING PARALYTIC FEET.

BY MICHAEL HOKE, M.D., ATLANTA, GA.

In making anything the artisan must know the material he is to fashion and have a definite idea of what he intends to make. This is as true of plastic surgery as it is of any other manual art.

The results we seek and produce by operating upon a paralytic foot depend upon an accurate, detailed knowledge of the architecture of the normal leg and foot skeleton, of the deformed leg and foot, of the relation of the weight thrusts to the architecture, and of the relation of these to the action of normal muscle power and the disturbances of muscle power produced by paralysis. It is impossible to convert a paralytic, deformed foot into a normal foot. What, then, can we put down as a standard type of result to be obtained by a method which produces the result with sufficient frequency to make it useful and worthy of our recommendation? It seems to us that feet that have been operated upon should possess the following qualifications: First, they must look natural in shoes; second, they must be so stabile that they will not turn laterally on the long axis of the foot when the patient is standing and walking; third, they must be so stable in the natural or nearly natural attitude that they do not need braces to hold them so; fourth, when barefoot they should look natural or, if that be impossible, nearly enough so to present no gross deformity. For example, a bad club foot often cannot be made natural in appearance. If it shows slight mid-tarsal and metatarsal varus, but the placing of the foot on the ground is correct, one would consider the result a finished one for this particular foot.

Only since we have learned to do this operation have we, in Atlanta, been able to obtain results that meet the above requirements. We have tried for several years to find an architectural operation which was reasonable in principle. This one seems so and has been surgically satisfying.

Tendon transplantations have, in our experience in the past, been distinguished by their failure, except in a few cases. We have regarded tendon transplantation done alone as unmechanical. We have regarded the fixation of tendons to bone to control lateral deformity as unmechanical and have, therefore, done no operations of this nature. We have done no silk insertion operations for this purpose for we did

not believe they would hold against the powerful body weight thrust. We have not done Davis' operation for it is done blindly and does not take into consideration the architectural details which we think are fundamental if one would produce results filling the above qualifications.

From 1914 to 1817, the brace-free feet we could produce were those upon which astragalectomy was done. Astragalectomy, except for the calcaneus type of deformity for which Whitman devised it, and possibly for flail feet, is certainly an objectionable operation.

We did the first one of these stabilizations in January, 1917. In 1917 we did some astragalectomies and some stabilizations. Since the middle of 1917 we have done the stabilization operation alone, or in conjunction with tendon transplantation. The operation has been done in 104 cases in the Scottish Rite Crippled Children's Hospital up to January, 1921. We have had the opportunity to see only 57 cases of the 104 at the end of periods varying from six months to three years after operation. All have been stabile. One case showed sufficient gross deformity to need better balancing by operating again.

In our clinic today, the stabilization operation is made the fundamental basis of all surgical plans for paralytic feet that show much architectural deformity and much loss of muscle power, for we believe a stabile, skeletal foundation is necessary if we would repeatedly obtain the desired result.

Why should the skeleton be stabilized? Between the foot and leg there is universal joint motion. Necessary as it is for flexibility of the foot possessing normal muscle control, it is not an easy thing for normal muscles to control and stabilize it. One has only to think of the flat feet of children and the foot strains of adults to suggest the difficulty.

Think how well a patient can walk on an artificial limb after an amputation below the knee. The patient with a bad paralytic foot deformity walks worse than the patient on the artificial limb. Structurally, the artificial limb is a stable thing to stand on. Suppose you should insert a universal joint between the foot and leg part of the artificial limb. Imagine the use it would be to the patient. And would he be satisfied with the job if a mechanic should tack strong strips of leather across the joint? No. They would not hold against the body weight thrust. The patient himself would suggest the removal of the universal joint and that the apparatus be made stable again.

After muscle balance has been upset and much power lost by paralysis, and the architectural changes have taken place in the skeleton, the

patient walks on a unversal joint over which he has no control. He has lost the stability that normal muscle power and brain control gave him. We do not think he can get his stability again and keep his universal joint motion. We think it necessary to do away with the universal joint motion.

It is fortunate that the motion between the foot and leg, though of a universal joint type, is a compound of motion in three places, namely, the ankle-joint, the subastragaloid joint and the astragalo-scaphoid joint. For good function it is necessary to retain the aknle joint. For architectural reasons, which imply the retention of a shapely ankle and posterior foot, it is necessary to retain intact the articulation and bearing points between the astragalus and tibia and fibula. It is necessary to stabilize the subastragaloid and the astragalo-scaphoid joints. This operation does this, and enables one at the same time to correct the posterior foot deformity.

There is some difference in the details of the operation on the various types of feet, for the architecture of a drop foot, a club foot, and a flat foot are quite different. And then, too, there are mixed types. The difference lies mainly in the way the head of the astragalus is replaced. It is put back in a certain position for drop foot, a certain position for flat foot, a certain position for club foot, etc., so that we type the stabilizations in the operating room as "drop foot type of stabilization," "flat foot type of stabilization," "club foot type of stabilization," etc.

Since it is the purpose of this paper only to make clear the reasons, as we see them, for stabilizing the feet under discussion and to report the fundamental details of the operation, which we now know will stabilize them in an advantageous way, we will use for illustration a simple type of foot, a drop foot with no posterior foot architectural deformity, a foot in which there is much lateral instability, a foot over which muscle control has been lost, except in the weakened but not totally paralyzed gastrocnemius-soleus, the flexor longus digitorum and the flexor longus pollicis. To carry the idea a little farther, we will point out the things of interest in the architecture of two other types; a flat foot and a club foot, and the application of the operation to these types. A little later we will go over the various types that have been done and report them in separate papers.

Description of the Operation.

The skin incision extends from over the external portion of the head of the astragalus downward and backward to the peronei tendons

FIG. 3.

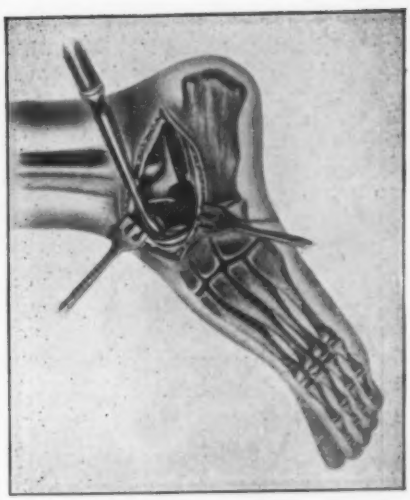

FIG. 4.

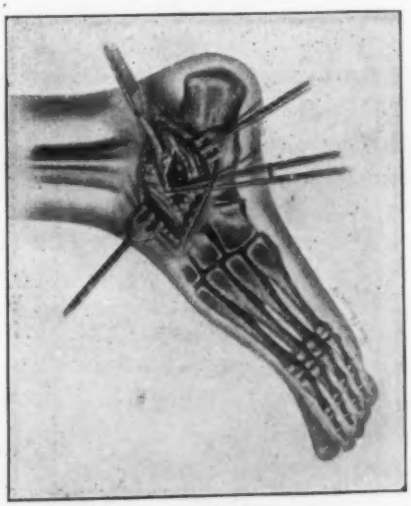

FIG. 1.

FIG. 2.

FIG. 7.

FIG. 8.

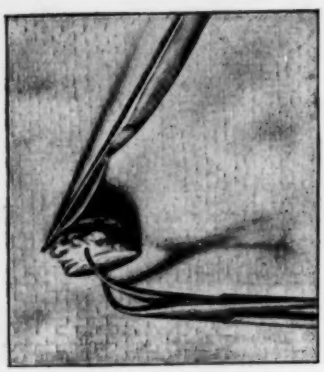

FIG. 5.

FIG. 6.

FIG. 9.

FIG. 10.

FIG. 11.

below the end of the fibula. The incision and exposure shown in the illustrations are different from the incision and the exposure made at the operation. To show the bone details, the artist had to disregard other things. Give the name "subastragaloid fossa" to the space bounded above by the neck of the astragalus, below by the superior surface of the os calcis and behind by the body of the astragalus. The adipose tissue occupying the subastragaloid fossa is split. The upper portion of this tissue is grasped and dissected out (see Figure 1), so that the under surface of the neck and adjacent portion of the body of the astragalus is denuded of all tissue. The inferior half of the tissue occupying the subastragaloid fossa is dissected out so that the superior surface of the os calcis is bare. Shift a retractor so it will lift the structures above the neck of the astragalus. With the knife point hugging the bone, the superior surface of the neck of the astragalus is made bare of all tissue. Next, free the head of the astragalus from the scaphoid, cutting the astragalo-scaphoid ligament, with the knife beginning low and externally and sweeping around the head, ending internally. With hammer and osteotome, a portion of the inferior surface of the body of the astragalus is removed. A portion of the adjacent surface of the os calcis is removed. Next, the neck of the astragalus is cut through where it joins the body. Figure 2 shows the bone cuts. The amputated neck and head of the astragalus is grasped with sharp pronged forceps. A spoon-shaped instrument is slipped in between the head of the astragalus and scaphoid. The head of the astragalus is levered partly out. The remaining attachments are cut with scissors (see Figure 3). The neck and head of the astragalus are placed in a towel and laid on the instrument table. The cartilaginous surface of the scaphoid is then denuded with a curette (see Figure 4). The cartilaginous facet on the superior surface of the os calcis, on which the foot rotates laterally on the head of the astragalus, is denuded with a small chisel.

In a pure drop foot we are not confronted with architectural deformity of the body of the astragalus and the os calcis, but in the other types of deformity one finds that at this stage of the operation, with the head and neck of the astragalus out and the body of the astragalus freed from the os calcis, he is able to correct the posterior foot deformity, to set the posterior end of the os calcis in line with the center of the leg, to shift the os calcis laterally in line with the central axis of the leg, to correct lateral rotation of the os calcis, to pitch the heel up or down, and to shift the foot back, as Whitman has pointed out as so essential in his astragalectomy. The posterior foot is

subject to the operator's wishes and the setting his fingers may give it. The head and neck of the astragalus, that was laid aside for a moment in a towel, is taken in forceps and the cartilage on the head is shaved off with a knife just to the bone beneath it. (See Figure 5.)

Refer again to Figure 2, and you see the neck of the astragalus is quite long, curved and a little hooked down. The weight thrust is transmitted to the anterior foot by the head of the astragalus and in the direction of the axis of the neck. Such a type of astragalus contributes architecturally to the pitching downward of the anterior foot. If you now cock up the anterior foot and retract the wound, you will see that the amputated head and neck piece is too long to go back. Hold the piece on a 3 x 3 x 1 wooden block and cut off with hammer and osteotome just enough of the posterior end of the neck so that when you put the head and neck piece back, it will nestle in place between the scaphoid and body of the astragalus without obstructing the cocking up of the anterior foot. Be sure to "sink" it down on the upper surface of the os calcis. It is necessary at times, in order to "sink" the head, to cut off a little of the under surface of it.

The foot is held by the operator as in Figure 6, and until the plaster is set he continues to hold it so. The assistant sews the subcutaneous tissues with interrupted No. 1 catgut sutures. The skin is sutured with interrupted silk sutures, being careful not to infold the skin. Plaster is applied to the knee, being careful to hold the foot as in Figure 6.

In addition to the paralysis of the anterior muscles, there are three other things that contribute to the drop foot gait after the condition has been present for a long time. First, the motion between the head of the astragalus and scaphoid, which is much greater than normal, due to ligament stretching; second, the lengthening, and in many instances, the hooked-down curve in the neck of the astragalus, and third, the structural pitching down of the shafts of the metatarsals. In the setting after operation, one cannot always correct the downward pitching of the shafts of the metatarsals to the desired degree. If he cannot, then, after the foot has been in plaster five weeks and the cast comes off, the patient is given an anaesthetic and by manipulation of the centre of the tarsus, it can be forced downward and the anterior ends of the metatarsals lifted up. This will correct the metatarsal architectural feature without disturbing the setting of the posterior foot (see Figure 7). The foot goes back in plaster for two weeks. We find that 6½ to 7½ weeks for children and 8 to 9 weeks for adults, is the proper length of time to keep them in plaster. The

FIG. 12.

FIG. 13.

FIG. 14.

after-treatment consists only of about two weeks' massage and the putting on of a shoe.

Figure 8 and Figure 9 show the fusion that occurs.

The end result for the above type of case is a foot that possesses the qualifications of the end result desired and mentioned in the beginning of this paper. The toe swings clear of the ground without a high knee action effort, with one exception. When the quadriceps extensor is quite weak, with the hamstring and gastrocnemius-soleus muscles strong, and the anterior group below the knee totally paralyzed, a lifting knee action is most difficult to do away with, and is oftentimes not done away with.

Figure 10, an anterior view, shows the normal architecture of the leg and foot skeleton. The axes of the knee and ankle are well in

CASE I.

CASE I.

CASE II.

line; there is no twist in the tibia; the axis of the neck of the astragalus, if prolonged forward, passes through the anterior end of the first metatarsal. The architecture, the axes of the joints and bones, the relation of the weight thrusts are suitable to the preservation of the natural attitude of the leg and foot under normal muscle control.

Figure 11 shows the architecture of the leg and foot of a paralytic flat foot of pronounced type. How different from the normal! Note the torsion of the tibia which throws the relation of the axes of the knee and ankle out of line; the breadth across the neck of the astragalus; the downward and inward pitching of the neck and head of the astragalus, and note that the scaphoid has slid upward and outward on the head of the astragalus and that the shafts of the metatarsals are almost parallel with the horizontal ground surface. The arrow through the neck of the astragalus defines the action of the weight thrust. Can one with an appreciation of the above considerations expect anything but a skeletal operation to fit such a condition?

Figure 12 shows the application of the "flat foot type of stabilization" to this type of architectural deformity. Note the position of the

CASE II.

CASE III.

reimplanted head of the astragalus where it should be placed in this type of the procedure. If it were put back in its former position, relapse would occur. If it were put back in the normal position, relapse would occur. With the scaphoid placed a bit to the inner side and under the reimplanted head, as depicted in Figure 12, relapse will not occur, if, too, all other deforming factors are removed. Note the correction of the torsion of the tibia by the tibial osteotomy. Note the transplantation of the extensor propius hallucis to the internal cuneiform bone.

Figure 12 shows a type of architecture of the leg and foot skeleton seen in paralytic club feet. Just as different as the flat foot type is from the normal, is this, in other details, different from the normal and the flat-foot types. There is one detail alone that is like the flat foot type, namely, the torsion of the tibia. The shape and the position of the neck and head of the astragalus, the direction of the axis of the neck, the position of the scaphoid in its relation to the head of the astragalus, the way it is tied to the head by ligaments, the position of the os calcis

with reference to the central axis of the leg, the relation of the shafts of the metatarsals to the ground horizontal are all different.

Figure 13 shows the alignment of the leg after correction of the torsion in the tibia, the application of the club foot type of stabilization and the transference of the attachment of the anterior tibial to the centre of the tarsus. Note the position of the reimplanted head of the astragalus. It is necessary in some club foot cases to replace the head somewhat internal to the position in which it is placed in this illustration.

Photographs of types of cases before and after the stabilization operation are included in this paper to show the appearance of feet before and after the architectural correction.

It is the purpose of this paper to report the operation which we have found to be useful, and therefore feel like recommending to others to try out, to focus their attention on the fact that the architecture of the deformity to be dealt with must be considered, that the alignment of the leg is important, that, in our opinion at least, the universal joint motion must be done away with, and that this operation permits this to be done and enables us at the same time to correct the posterior foot deformity.

DISCUSSION OF DR. HOKE'S PAPER.

DR. A. BRUCE GILL, Philadelphia: It is unusual and gratifying to find the almost unanimous expression of opinion here this morning as to the necessity of skeletal fixation to stabilize the lower extremity, particularly the foot. Orthopaedic surgeons have been trying for years by means of operations upon the soft parts to stabilize the foot, but are now coming more and more to the realization that an arthrodesis or skeletal fixation is the operation of choice.

I cannot speak too highly of the work of Dr. Hoke. Indeed, it speaks for itself and needs no commendation from any of us.

I desire merely to point out how similar is the operation of Dr. Hoke to the subastragalar arthrodesis of the late Dr. G. G. Davis. These two master orthopædic surgeons arrived independently at almost the same end long before nearly all other surgeons were ready even to accept the principle of skeletal fixation. The subastragalar arthrodesis of Davis produces a fusion of the astragalus, the os calcis, and the scaphoid. This fusion is secured by a thorough digging up of the joint surfaces by means of gouges, without the removal of any portions of bone from the wounds. Dr. Hoke likewise secures an arthrodesis of the same joint. It may be stated here that the subastragalar joint includes the articulation between the scaphoid and the astragalus together with that between the os calcis and the astragalus. Dr. Hoke removes the head of the astragalus, cuts off its cartilaginous surfaces and restores it to such a position as to allow correction of the existing deformity of the foot. In the Davis operation, after the subastragalar joint is thoroughly gouged up, the foot can be moulded and placed in any position desired. It can be moved from side to side, rotated inward or outward, moved forward or backward, because nothing but the soft tissues maintain connection between the foot and the leg in the horizontal transverse plane beneath the astragalus. If the head of the astragalus so projects as to in-

terfere with the proper reduction of deformity it is removed in pieces with the gouge, and the fragments are allowed to assume whatever position they will as the foot is put into the correct position beneath the leg. These fragments of cartilage and bone assist in producing a thorough fusion between the bones.

It may here be stated that the triple arthrodesis of Ryerson is the subastragalar arthrodesis of Davis plus another thrust if the gouge between the os calcis and the cuboid. If the subastragalar arthrodesis is done thoroughly, an additional arthrodesis of the os calcis and the cuboid is unnecessary.

The point to be emphasized is that an arthrodesis of the foot is essential to the permanent and satisfactory correction of deformity and production of stability, and that the operations of Hoke and Davis alike give such splendid results because they are identical in principle and differ only in smaller detail.

DR. CHARLTON WALLACE, New York City: Dr. Hoke is certainly to be complimented upon his mechanical genius. If I understood him correctly, the whole object of his operative procedure in this type of work is to establish weight bearing and walking ability in the foot; also to bring about a normal line of gravity by the operation upon the tibia. He also secures stability. One's own personal experience will certainly lead one to adhere to the operative procedure that secures these three things best for the patients and withstands the test of time.

The weight of the body is transferred to the foot through the body of the astragalus. It is almost the same as if a marble were put in the middle of the foot. It is next to impossible, through tendon transplantation *per se*, to obtain a stable walking foot, because there has been lost one of four of the pulls trying to balance the foot upon a marble. Therefore, for a decade or more some of us have not been attempting to do tendon transplantations alone upon these feet. My experience is such that I am a through advocate of astragalectomy as performed after Dr. Whitman's method; even for muscles where there is adduction deformity of the foot and an overacting tibial muscle, the astragalectomy can be combined with a tendon transplantation. Therefore, in stabilizing the foot, I have personally adhered to the astragalectomy. It obtains some things that we have heretofore never been able to secure. It gives good weight bearing and walking function to the foot. It is also preferable to any operation that I know of where both feet are involved. There is some suspicion of shortening where it is a unilateral affliction, but that is so inconsequential that its consideration is really not worth while. It is hard to get, in this discussion, in so short a time, one's experience.

From having worked on these cases ten or twelve years and observing, perhaps, anywhere from a hundred and fifty to two hundred and fifty cases, I can say this: I have absolutely not, in any case that I have ever operated on, observed an instance in which the patient was not materially benefited by the procedure. There has been a gain of function after the operation. The immediate loss of shortening obtained by the operation is counter-balanced by the gain in lengthening, comparatively speaking, that one gets in most of these cases by the time the patient is twelve or fifteen years of age. We have, by that time, only three-quarters-of-an-inch of shortening. It prevents delayed shortening by the increase in the circulation in the foot, and in the cases where chilblains occurred before the operation they do not recur afterwards. The child is young and must develop and does so much better if able to stand and walk without braces, and certainly these children so play without braces. The physiological use stimuates the growth of the affected extremity.

I have watched these cases for years after they were operated upon. Only the other day a boy of eighteen reported to me at the Reconstruction Hospital. He had had an operation on both feet seven years ago. In one lower extremity he had activity and power only in one hamstring. There was absolutely no power in a muscle below the knee. He now a farm laborer and

wears no brace. It was most gratifying to see this boy come in and say that he was doing ordinary common farm labor. I do not know any other operation that would give this boy that power.

DR. OSGOOD: Dr. Hoke, will you please close the discussion?

DR. HOKE: May Dr. Wallace state what age he would prefer for the operation?

DR. WALLACE: Six years; but I have done one or two cases at the age of three. The age of the patient is not the indication of the time to operate. One operates on these cases from two to three years after the original onset. I have done some cases as early as the age of three years.

REPORT OF THE COMMISSION APPOINTED TO INVESTIGATE THE RESULTS OF ANKYLOSING OPERATIONS OF THE SPINE.

E. G. BRACKETT, M.D., W. S. BAER. M.D., J. T. RUGH, M.D.

THE COMMISSION has confined its report to data based on the cases personally examined by its members, and the aim of this report has been to give the results of the operations on tubercular spines, performed with the object of producing ankylosis. The two principal methods of operation, namely, fusion and inlay graft, have been used in practically all of these cases, with the exception of a few cases in which a combination of the two was used. No attempt has been made for a comparison between the methods of operation, other than to present the data obtained, for the object of the Commission has been to present the results of ankylosing operations of the spine, in order to determine the value of this procedure in these cases. No differentiation of relative influence of mechanical treatment and of operative treatment on the course of the disease has been made, and in the large majority of cases it is not possible to differentiate the results of the operative procedure alone, for the reason that in so many cases it has been an incident in the course of treatment, and the mechanical treatment which had been begun was continued for long periods afterwards.

It would not have been possible to find, from the return cards alone, the necessary data to compile a report, as the information contained

was not sufficiently complete and accurate for use. Also, it seemed evident, that for the sake of uniformity, the individual equation of the operator should be eliminated. It was decided to use only the facts obtained by personal examination of the patients, and of the x-rays, by the members of the Commission.

Letters and circulars were sent to all the surgeons of the American Orthopædic Association and also to surgeons, not members of the Association, but known to be active in orthopædic work. From these, a certain number of questionnaires have been received, and deductions drawn which may be used to give either impressions or opinions obtained by a large number of competent surgeons, and which must be considered separately from the report of the Commission. As a rule, the records kept were not sufficient to furnish data. Also, many institutions have suffered from the loss of x-rays which form the most valuable data for record, and in many cases these x-rays have suffered a wholesale destruction, in addition to those which have been lost because of lack of proper system of filing and storage.

The Commission has been greatly handicapped by the laxity of methods which the individual members of this Association have pursued in keeping proper records of their cases. The situation is the same with regard to the hospitals with which the members are connected. With few exceptions, the proper data necessary to the work of this Commission have been unobtainable; the follow-up system in most of the hospitals has been woefully lacking—practically does not exist. In one hospital only, and that one served by a man not a member of our Association, have complete and accurate date been obtainable and furnished to the Commission.

The results of the fusion operations are from practically one operator and treated under the same conditions: the great uniformity of these results, and the excellent condition of these patients are a distinct indication of the influence of the character and the technique of the operation and of the operator and the systematic attention to the immediate after-care. The choice of the case, the technique of the operation, the character of the subsequnet care, are large factors in determining the end-result.

The features of special importance bearing on the clinical course of these cases have been considered, and the cases studied with reference to them. In making this report, the Commission has demanded, besides a sufficient history of the case, an x-ray picture of the case before operation, the case itself in person, an x-ray picture of the case immediately following the operation, and x-ray pictures at least

two years after the operation has been performed. The following features of the operation were studied:

1. The influence on the subsequent development of deformity.
2. The arrest of the destructive process.
3. The influence on the acute symptoms.
4. The production of fusion of the bodies of the vertebrae.
5. The effect on abscess.
6. The effect on paralysis.
7. The operative risk.
8. The functional results.
9. Mortality.

1. The Influence on the Subsequent Development of Deformity.

The ankylosing operations alone, by either method, cannot be depended upon to prevent the increase of destruction or deformity. Apparently, the deformity does increase equally with the operative and with the mechanical, as ordinarily employed in this country. The deformity is not always proportionate to the added destruction of the bodies of the vertebrae, as it may vary in the usual course of these cases, by the gradual development of compensatory curves. Cases in which the mechanical treatment has been continued for long periods following the operative method, have, in general, shown a markedly less degree of deformity, than those cases in which mechanical treatment was abandoned early, or inefficiently carried out. This is particularly true of children.

The development of deformity naturally is influenced by the age of the patient, and the records show a very much larger percentage and also degree of increase among the younger children during the plastic and growing periods. To determine the data on this feature, the cases have been placed in three groups: The first includes those under five years, the second those between five and sixteen years, and the third those over sixteen years. Results are shown in table on page 510.* It is to be seen, therefore, that deformity is not materially influenced by the operative methods of treatment, unless supplemented by thorough mechanical support, for these results include cases of both lumbar and cervical disease, in which the amount of deformity in the convalescent periods is not marked as a rule.

The later examination of these cases shows that too much dependency cannot be placed on operation, either by fusion or inlay, to protect the spine against further development of deformity, or to prevent strain of the back in the ordinary course of daily life of the patient.

So far as this fact is concerned, operative interference must be looked upon as an incident in the course of treatment, and the protective and supportive treatment in children must be continued almost as long as in cases in which operative method is not used. Not only can the inlay bend with increasing curve of the spine, and yet remain in position, as has been beautifully shown in one case, in which there was a large increase of deformity, and in which x-rays indicated that gradual development of the knuckles and the change in the shape of the graft correspond to the changed position of the spine, but also, the inlay may break even after a considerable period. In all of these cases symptoms reappeared.

The experience with a number of the cases has shown that too much dependence must not be put on the protection afforded by the inlay itself. Although this may vary largely with the size of the graft, it is probably not due to the size alone, since fracture has occurred in the cases of all the operators who have used the inlay method, and this has also occurred in one case of fusion. This fracture of the graft has happened in a period varying from one to three years. Although the statement has sometimes been made that the rupture of the graft does not materially influence the fusion of this part of the vertebrae, this has been shown to be erroneous, as in a majority of these cases showing a fracture of the graft, acute symptoms have reappeared. In one case, the graft broke both above and below the two diseased vertebrae, but held between the spinous processes of the two bodies, which showed destruction. This case showed a good functional result. Another case showed a fracture, or a failure of union between the spines

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* TABLE.

Number of cases examined	96
Abscesses before and remained	10
Abscesses before which disappeared	8
Abscesses appeared after operation	7
Paralysis before and remained	1
Paralysis which disappeared	7
Paralysis after operation	2
Infection	2
Cases under 5 years	32
(Increase in deformity	24)
Cases 5 to 16 years	48
(Increase in deformity	32)
Cases over 16 years	16
(Increase in deformity	5)
Ankylosis	77
Fusion	18
Mortality	3
Number in complete block of cases	176
Mortality	16

of the last diseased vertebra and the vertebra below. This case did not show ankylosis, and had only a fair functional result. One case showed a fracture of the graft three years after operation, following which symptoms developed; in another case, a fracture developed eighteen months after operation, while the patient was lifting a heavy weight. Although this experience demonstrates the value of the graft, so long as it is firm and in position, it also suggests the necessity of a large and firm inlay.

Ankylosis of the Operative Field.

The ankylosis in the operative area cannot be determined by the x-ray, particularly in the case of the fusion operation. In the case of the inlay, the graft can be easily seen in place, and its integrity demonstrated, but the ankylosis in the posterior part of the vertebrae, which is, of course, to be desired, cannot be shown either in the antero-posterior or in the lateral view. The presence of ankylosis was determined by the symptoms, the immobility shown by examination, lead tracings in different positions, etc.

In the great majority of cases (80%), ankylosis of this area was found to be present, the percentage varying directly with the age of the patient.

Fusion.

Ankylosing operations have had apparently little effect on the production of ankylosis of the bodies of the vertebrae. Among the cases examined, 18 showed actual fusion of the vertebrae, and these were cases in which four or five years had elapsed since the observation made by the first x-ray. In these, there was complete fusion of the diseased area, which gives the ideal end-result, and which alone can be called an absolute cure. These cases were all in the younger subjects. No instance of fusion was seen in the adults.

Influence of the Operation Upon Acute Symptoms.

Although the successful ankylosing of the posterior part of the spine by either method may not seem to arrest the development of deformity, it undoubtedly does exert a favorable influence on the acute symptoms. While the available records in the large majority of cases do not give sufficient data as to the presence or absence of acute symptoms before and after operation, the evidence obtained from those in which records were available supports very strongly this opinion. In spite of rather imperfect mechanical fixation, the acute symptoms even with

the ambulatory cases in the early post-operative period, and in the cases treated in the hospitals in which after-care is not well under control, the occurrence of after-symptoms was, on the whole, rare.

Abscess and Paralysis.

The effect of the operation upon abscess or paralysis cannot be determined in this series, since cases of both abscess and paralysis are too few to give sufficient data upon which to base an opinion. The information obtained, however, warrants the conclusion that in both of these conditions, the operation exercises a favorable effect. Whether or not this is in part due to the recumbency following the operation is difficult to determine, but it is highly probable that enforced rest exerts a distinctly favorable influence.

Mortality.

The records of these cases show two distinct and important features, namely, that this operation itself is not one attended by a large mortality, and also that infection is not to be expected, as this was recorded in but two cases. This is equally true of the inlay and the fusion operation. In computing this, the deaths which occurred within two months of the operation were considered as operative, whereas, those occurring in a later period were considered as due to some intercurrent disease, or possibly to exhaustion, which may have been aided by the shock of the operation.

The figures which are given by the return cards show the fallacy of determining results by data on the ordinary questionnaire, at least in the present state of record-keeping among medical men in general, and this includes both hospital and private records.

In 163 cases from which data were returned, from different operators, only three deaths were recorded; two of these were post-operative occurring within two years after the operation, and one, operative mortality. This gives a very low percentage of mortality for an operation of this magnitude. On the other hand, when a complete series is followed, and complete data obtained upon a series as a whole, with the end-results in each case, the element of mortality assumes very different proportions. In the one series in which these records have been obtained (this series is comprised of a definite block of cases done within a definite period of time), and in which the end-result was obtained in practically every case, the mortality assumed rather alarming proportions.—16 cases of death in 137 cases operated. In this group of 16 cases, three were classed as operative, occurring

within two months of the operation, six were recorded as due to meningitis or pulmonary tuberculosis, a cause which could be considered indirectly connected with the disease. The other cases must be considered as due to intercurrent disease,—influenza, whooping cough, acidosis, etc. This series is most valuable, particularly when compared with the data received in the ordinary questionnaire. It emphasizes in the strongest manner the value of following up the final results, in order to establish data on this problem of end-results, with operation or any form of treatment. It also shows the need of following up cases requiring long convalescence in order to establish the fact of complete recovery and to determine the value of any particular form of treatment. The figures given in this series do not necessarily indicate a greater mortality of the operator, but suggest what has probably happened to a large number of cases of all operators who have not a complete record of the end-results. In one other smaller series, in which the records kept were far above the average, three deaths were known to have occurred in a group of 18 collected from a series of 37. These were all in the post-operative period, and would have been regarded as probable successes had not the end-result been accurately followed up. These figures also show the absolute necessity of reports being made only upon such cases as can be examined personally by a Committee, and also the necessity of complete records of both before and after conditions, in order to make a report of value

The age in which operative interference should be attempted is a question. The mortality among the younger children certainly shows a much larger ratio, not only in the operative period, but also in the post-operative period. Whether or not this is due to the exhaustion of a rather severe operation cannot be determined, but it would be suggestive, since in the series of 16 deaths, one-half died within the first year, although of intercurrent or allied disease, in which the exhausted condition may easily have played a part. In view of the imperfect ossification in this early period, the advisability of operation on the younger cases, it is still more essential that the rigid apparatus treatment should be thoroughly and long continued.

The operation should be regarded as an incident only in the treatment in these cases, and the fixation and supportive mechanical treatment should be carried on sufficiently long to afford opportunity for the ultimate fusion of the bodies, if such a result is possible. A cure can hardly be considered as assured until the child has passed the second period of growth.

This investigation has demonstrated certain valuable facts in regard to these operations. It has also demonstrated that to follow up the true end-results of any group of cases, a new era in the methods of record and follow-up must be instituted. In one group only has this record of a group of cases been possible, but which proves, however, that the task can be done. Unless the end-results of practically all of the cases may be had, the conclusions will be futile, and they will err on the side of producing more, rather than less, favorable results than actually exist. It is to be suggested, however, that the system of follow-up be advised, or a definite method of examination and record, and that all those interested in such information should collect such data as might be used in the future for an investigation and study, such as has been the object of this Commission.

DR. DAVID SILVER, Pittsburg, Penna: The Committee is to be congratulated on the completeness, impartiality, and judicial character of its report. The work is sufficient evidence of the great value of this form of investigation. I came here with a number of points which I considered of especial importance but practically all have been covered.

It seems to me wise that the Committee has left the question of the preferable method of operation undecided, as there would naturally be a considerable difference of opinion on that point; there is evidently no question however, that, when properly performed, a successful anklylosis can be secured by either method, so that the problem becomes one mainly of the effect on the symptoms, the extent of the deformity, and the final function.

I do not recall that anything was said of the danger of pulmonary embolism following the inlay graft; this, I think, should be included, as one of my cases had such an unfortunate ending.

Especial study, it appears to me, should be made of the effect on the function of the spine from the standpoint of the extent of the segment ankylosed. In the early stage of the disease we have no definite means of determining how far the disease has extended and of course cannot know how far it may extend subsequent to operation; we must, therefore, extend our operation well beyond the recognized limits of the disease and so ankylose a fairly large segment of the spine, so that the end-results from this standpoint cannot possibly compare with those obtained by the natural methods of healing.

DR. E. W. RYERSON, Chciago, Ill.: I was, unfortunately, not able to hear the earlier part of the report. The proposition is simply a mechanical one in my opinion. We know that if the spine can be held still long enough, most cases of tuberculosis of the spine will get well. Whether we get them well more quickly by operation than by mechanical treatment, is, to my mind, the important question. We can fuse the spine by any one of various methods. It takes an immense length of time for uncomplicated tuberculosis itself to fuse the spine. It takes years, and dozens of years, in many cases, for tuberculosis without secondary infection to fuse the spine. Cases with abcesses fuse more rapidly than those without abcesses. It is my belief that a fusion operation is warranted in any case in which the patient is a good operative risk, barring small children. I no longer do these fusion operations on children, if time is no particular object. I think that adults who have tuberculosis of the spine should have a fusion operation, if they are good operative risks.

With regard to children, the operation does not shorten the length of treatment very much. You have to go on treating them with apparatus for a long time, but patients so treated do not show the tendency to recurrence that unoperated cases do. It is appalling to see the cases come back that were not operated on. They come back ten or fifteen years after we believe that they were cured, some with pain, some with abcess formation, and some with paraplegia. I believe that the operation is fully justified by the results in properly selected cases and where the operation is properly performed.

DR. OSGOOD: We are fortunate to have Dr. Calvé with us, and he is willing to discuss this paper.

DR. JACQUES CALVÉ, Berck-Plage, France: It is not my intention, in this brief paper, to contrast one therapeutic method with another. I desire only to show the results obtained through the French method of treating Pott's disease among children, with my modification, and to analyze these results.

This treatment in its general outlines consists in:

First, requiring the patient to maintain a recumbent position for a minimum of three years.

Second, placing the vertebral column in hyper-extension,—following rules which vary according to the location of the lesion, with or without the application of plaster apparatus.

Third, having the patient live in the open air—preferably at the seashore—giving him the greatest possible benefit of the sun cure and supplying him with healthful and abundant food—avoiding over-nourishment.

The cases in this series are of children. Pott's disease presents a different problem in adults.

A child under this local and general treatment possesses the marvelous quality of becoming entirely cured, in the anatomical sense of the word; of producing cicatrization of the vertebral lessions. In the case of a child, Pott's disease passes a veritable cyclic evolution; an infiltration phase, followed by one of ulcerous destruction, and it is only in the third year of this evolution that the process of building up commences, and this is completed between the third and fifth year—according to the capacity of the patient to cicatrize, and to the extent of the lesion. Never, in the course of the autopsies made at Berck upon children afflicted with Pott's disease, and dying from other causes, has any trace been found of the reparation process prior to the third year. We cannot insist too strongly upon this fundamental fact, too generally unknown.

The cicatrization is at first fibrous, afterwards bony. In a closed focus of Pott's disease this bony reparation is never accompanied by a bony neoformation, as in the case of an area of a fracture, or a focus of osteomyelitis. Bony consolidation must be obtained by juxtaposition. There is never a bony growth thrown out between two surfaces separated one from the other.

Corrective changes of the more or less acute angular deformation which is characteristic of Pott's disease are gradually produced during these processes of healing and treatment. These corrective processes—some, spontaneous, the others provoked—develop either in the focus itself (these are intra-focal corrections), or above or below that focus (these are the extra-focal corrections).

It is especially in regard to these phenomena of correction that I shall attempt analysis, and I shall illustrate them by radiographic views taken in profile both in the lumbar and dorsal regions, and by outline drawings.

Lumbar Pott's Disease. The lumbar region favors two methods of correction:

FIRST—EXTRA-FOCAL CORRECTIONS.

These are easy to obtain, the lumbar region being normally hyper-extensible; it is the region of the lordosis. To obtain rapidly the compensatory curves, both directly above and below the focus, it is sufficient to place the patient in progressive hyper-extension, either by means of a plaster bed, a block of wood placed under the mattress, or by using a curved frame.

SECOND—INTRA-FOCAL CORRECTIONS.

Some are obtained early in the treatment, and some later.

(a) *Early corrections are easily obtained.* They occur spontaneously and rapidly as the destruction progresses, when the patient is recumbent and in hyper-extension. An anatomical disposition—peculiar to the lumbar vertebrae—explains these corrective phenomena; the pedicles and the arcs are not as high as the bodies and the discs. In the vertebral focus covering two vertebrae, the lower articular process of the upper vertebra can settle backwards and downwards; no obstacle interferes with this movement. But, on the other hand, it is facilitated by the bony groove on the posterior and lateral faces of the lamina. At this same time, with this destruction there occurs a physiological settling of the arcs and spinal processes, which only ceases when the point of the superior articular process of the lower vertebra strikes against the upper posterior surface of the inter-vertebral foramen of conjugation.

(b) *Late corrections.* Phenomena of a different and very important nature follow these phenomena of physiological correction about the third year; the laminae and the pedicles diminish in height by the action of the constant, dystrophic process, in the vicinity of a focus of bone tuberculosis. Finally, an added posterior settling is produced when the destruction of the body is considerable. The upper vertebral body slips slightly backward, and the upper articular process of the lower vertebrae ascends into the inter-vertebral foramen.

Two vertebral bodies can lose 7/10 of their height with a corresponding compensation in the disease area,—that is to say, there should never be any lumbar gibbosity.

DORSAL POTT'S DISEASE.

In contrast with the lumbar, dorsal Pott's disease is a far more difficult problem. This is in the region of large gibbosities; everything tends toward their development—the weight of the body, breathing, the normal kyphotic form, the normal physiology of the dorsal sector, because it is the centre of the movements of flexion, and it is impossible (in the movements of extension) to pass the upright position. Dorsal hyper-extension does not exist normally.

Contrary to that which exists in the lumbar region, the laminae and the pedicles are of the same height as the bodies of the vertebrae; posterior physiological settling is impossible. As soon as the disc is destroyed, the centre of the movements of flexion, which, normally, is found at the junction of the posterior third and the anterior two-thirds of the disc, is much displaced backward to the point of the superior articular process of the inferior vertebra; the two infected vertebrae crush together, pivoting around this point; this later is rammed against the inferior surface of the superior pedicle on a slippery surface of compact, burnished tissue, which conditions are eminently favorable to this movement of dipping forward; the equilibrium of the superior vertebra of the focus on the inferior vertebra becomes unstable just as is the case in a pair of scales where the beam oscillates on its fulcrum.

A dislocation of the vertebral articulations is the result; the laminae become separated, and "yawn" open backwards.

Recumbent treatment suppresses one of the most important factors of the aggravations, namely, the weight of the body. It partly annihilates the unfavorable action of the respiratory movements. However, no matter how early the treatment may be begun, there is almost always a notable angular deformity shown by the x-ray as a cuneiform focus with a posterior basis.

What corrections are to be hoped for under these circumstances?

Intra-Focal Corrections.

(a) Early ones: There are none.

(b) Late ones: They are very slight; about the third year of the evolution of the disease, a diminution in the height of the supporting articular process, (the one that serves as a pivot), and of the pedicles can be noticed, from which results a slight settling. The spinal process of the upper vertebra in the beginning is prominent, because it is almost horizontal, and later becomes shortened, and curves inward during the third year.

Extra-Focal Corrections.

Here is the knot of the question. It must be insisted upon.

Dorsal Pott's disease, because of the impossibility of hyper-correction—with the dorsal sectors adjacent to the focus above and below—can be compared to a fracture of a long bone which is knitting in a vicious position at an angle of deviation opening to the front. The patient is bent double, and if a means of redressing this forward inflexion were not found, it would be impossible for the patient to regain the attitude of a biped,—that is, for him to stand erect. This is the aim of the entire treatment. It could easily be attained, and even spontaneously, but at the price of a great deformity. It is easy, indeed, to provoke, or even to allow, compensatory curvatures in the physiologically hyper-extensible regions of the spine—above and below the focus—to establish themselves, but at a great distance from each other in the cervical and the lumbar regions. This is what happens in dorsal Pott's disease treated irrationally; the erect position is re-established, the position of a biped is possible, but at the price of a considerable dorsal deformity. The healthy sectors adjacent to the sectors above and below, which are not normally hyper-extensible, contribute to forming the gibbosity, whence the origin of a large, dorsal hump. The consequences, besides the deplorable aesthetic results, are grave; crushing of the thorax, insufficient haematosis, interference with the cardiac circulation, and—as a result—cessation of the body's development.

The orthopædic surgeon must prevent the formation of this gibbosity. Since as we have seen, he should not open up the focus by separating the affected vertebrae, because in all bony tuberculosis there is no bone growth without contact, neither can he, on the other hand, hope for an intra-focal settling. He must, therefore, apply his treatment exteriorly to the focus.

In the first place, he must prevent the formation of spontaneous and physiological compensatory lordosis, both cervical and lumbar. The large plaster corset, called "Minerva", going from the occiput to the coccyx, brings about this result.

Next must be provoked in the healthy segments of the spine, immediately above and below the focus, compensatory curves called artificial or therapeutic curves, as distinguished from spontaneous or physiological ones. It is by patiently, during months of time, applying a continuous pressure, a slow propulsion on the focus and especially immediately above and below, that one succeeds, in some manner, in overcoming the normal physiology of the spine, and according to Wolff's law, in modelling the adjacent healthy vertebrae and discs above and below the seat of disease.

Little by little the vertebrae open very slightly in front, the pedicles and laminae atrophy and curve inward, the articular processes diminish in height, and one thus succeeds in creating a corrective hyper-extension.

The result obtained must be maintained.

To gain this end, and to avoid the ill results of wearing too long the "Minerva" plaster corset (deformation of the chin, lengthening of the neck, and muscular atrophy) it is necessary to alternate the treatment by placing the patient in bed in total hyper-extension (plaster bed, curved frame, or

large block placed under the mattress). To obtain this result will require three years at the minimum.

From the analysis of these different facts it becomes very evident *that time is the prime factor* of our treatment.

It is not our intention to discuss generally the treatment by osteosynthesis; we only say that it is incompatible with our treatment. A graft in an early stage would prevent the progressive evolution of the corrective phenomena. Later on, it would be useless, since the focus has totally cicatrized. At the most, the advisability of a short graft in the dorsal region might be considered which would be applied only to the affected vertebrae, and on condition that no change should be made in the general treatment or in the duration of the recumbent position. Osteosynthesis could be added to our treatment in the dorsal region, but it could not replace it.

Several objections have been advanced against our treatment. The long period in the recumbent position is alleged to be injurious from a physiological point of view. Fifty years of experience in France, based upon the treatment of thousands of her children, make a positive response to that allegation. It suffices to pass a few days at Berck to convince one's self that the recumbent position brings no injury to the physical or moral development of the child.

This treatment is also alleged to be too expensive to be applicable to the poor.

Very poor reasoning, is our answer, for in trying to economize in the present they are piling up a large debt to be paid in the future. Those afflicted with Pott's disease, when insufficiently treated, are subject to relapses, and death or grave deformities are the results thereof, and from this is cast upon the country either a loss of life or a serious financial burden.

In our opinion, the creation of centres for treatment of tuberculosis of the bone, similar to that at Berck, would be of great advantage in the control of this disease. The patients and those connected with them would be disciplined; specialists would be created and trained.

It should always be borne in mind that every child who is afflicted with Pott's disease is the bearer of other lesions of the same kind, sometimes recognized clinically, but most often latent. For several years, the child should live in the open air far from town, and in such centres of treatment where it would receive the delicate and minute attention that its local and general condition require.

DR. GILL, Philadelphia: I wish to ask the members of the Commission a question. When a section of the spine is ankylosed by means of a bone transplantation or by a fusion operation, it would appear likely that the portions of the spine immediately above and below the ankylosed section are subjected to abnormal motion and strain to compensate for the absence of motion in the fused section. Did the Commission find any evidence to indicate that secondary foci of tuberculosis occur in these portions of the spine that are thus subjected to abnormal strain? Or, if they do so occur, do they appear here more frequently than in other portions of the spine? Within the past month I have seen three cases in which a secondary tuberculous focus had appeared just above or below a bone transplant, with no evidence to indicate that the disease was a direct continuous extension from the original focus.

DR. A. H. FREIBERG, Cincinnati: I think that we shall all go away feeling that nothing that we have done here will be more valuable in our future work than the discussion that we have had on the Report of the Commission, on the one hand, and the paper of Professor Calvé, on the other hand. The lesson that we should take away with us is, that everything we do must be done in such a way as to square with what we know of pathological physiology and what we know happens to the diseased segment of the spine, just as Ménard was able to show, in the old days of enthusiasm for forcible correction of Pott's deformities; we know that the disease cannot get well un-

less the surfaces are in apposition, and that the tuberculous foci are not placed where new bone formation can be expected to occur within a reasonable length of time. Indeed, it may not occur at all; so we must learn here that the graft which we place in the spine is only a more efficient method to assist us to splint the spine for a length of time, and that we cannot dogmatize in either direction. I might even accuse our distinguished guest, Dr. Calvé, of dogmatizing too much in his article in the *Revue de Chirurgie* some time ago, where he stated that whereas the vertebrae in the child fuse readily, those in the adult do not. But I have in mind the case of a woman of twenty-seven years, with paraplegia, in whom, after long immobilization treatment without operation, I got a perfect fusion, such as we get more often in the child, showing that the thing can happen. I think the lesson will be most practical, if we go home and study all the details with careful, mature, frank thought.

DR. J. T. RUGH, Philadelphia: I want to call attention to just one error in the reading of the paper. Dr. Brackett has given me permission to correct it. It was a slip of the tongue, and might create a false impression.

The statement was made that, of the eight cases of paralysis, seven had persisted, giving a percentage of 85, and one had recovered. Exactly the opposite took place. That is, following the operative procedure, or the long rest combined with it, the seven cases of paralysis disappeared, and one remained.

I think that the work of the Commission has been probably of more value to its members than it will prove to the members of the Association but the members of the Commission feel that they would like the members of the Association to participate in the advantages that we have enjoyed. It has shown undoubtedly the marked advantage of long fixation, and my own personal views have changed decidedly towards operative procedures. I am still strongly inclined to the operative treatment of these cases, and will continue my operative work. I feel, however, that our best results will be obtained after the age of fourteen or sixteen years. I feel that I shall continue to do the operation in children, believing that when the graft has taken hold or the fusion of the spine has been accomplished, that child, when it has attained adult life, will have a greater fixation of that spine than it would obtain under the simple mechanical treatment of the condition. I have secured the fixation of the posterior, as well as the anterior portion of the column. This, I feel, is one of the best safeguards that can be given to that patient.

One point that was made about the ankylosis or the fusion of the body of the vertebrae was that it must take place in the presence of a mixed infection, rather than that of a tuberculosis. We did not find that fusion took place merely in the presence of a tuberculous abscess, but it is through the influence of a mixed infection that we find secondary deposits in these cases.

One fact was rather strikingly shown regarding the rapidity of fusion or ankylosis in the diseased area and that was that when mixed infection was present, bone deposit was much more active than in the purely tubercular cases.

DR. W. S. BAER, Baltimore, Md.: I do not know that there is anything further that I can add to the Report of the Committee. I want to congratulate Dr. Calvé on the beautiful work that he has shown us. The whole matter seems to me to be boiled down to the fact that from the investigations that we have made, we should still keep the method of conservatism well before us. It does take a long time for a tuberculous process to fuse together, and that fusion of the bodies of the vertebrae has to take place before recovery entirely occurs. I can hardly agree with Dr. Rugh, if I understand him correctly, in the statement he makes that it is necessary for mixed infection to be present for fusion to take place in a tuberculous bone. I think, from an operative point of view, it is perfectly plain from the work of the Committee that you can get a fusion of the spinous processes in a

great majority of the cases either by graft or by means of fusion. By a fusion of the spinous processes, I do not mean a fusion of the body of the vertebrae, which we must get before a case of tuberculosis is going to be functionally cured. Therefore, the method proposed by Dr. Calvé, of a long period of recumbency, does give us a chance to get this fusion, although it takes a long period of time. The plan of the graft or fusion method itself does not prevent deformity. This still persists, not only in young children under four, but in 75% of the cases; and it does increase from five to fifteen years of age in 62 2-3% of the cases. It also increases in cases above sixteen years of age. I must say that in the cases we have seen, the general condition of the patient and the lack of symptoms seem to be better when the fusion operation was done than when we depend on the mechanical methods alone, such as are used in this country.

I think that we must draw the conclusion that simply an operation alone will not suffice to cure Pott's disease, and that we must keep up mechanical treatment until the bodies of the vertebrae becomes fused if we want to cure these cases.

FRACTURES OF THE FEMUR. END RESULTS.*

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My part in this symposium is to discuss the end results of fractures of the femur. In order to gain the proper perspective, I have reviewed the literature of the past five years and have carefully, with the assistance of Dr. J. I. Mitchell, studied the records of 222 consecutive cases in the Mayo Clinic. The literature on the subject is so abundant that I shall not attempt to discuss it, but proceed at once with the discussion of data concerning the patients who have been under our care.

Fifty-seven of the 222 patients had sustained fractures recently; the remaining 165 presented the end results of treatment which they had received elsewhere. These patients came to the Clinic because of malunion, delayed union, nonunion, chronic osteomyelitis, stiff joint, and so forth.

* Presented before the American Orthopedic Association, Boston, June, 1921.

RECENT FRACTURES.

Eighteen of the fifty-seven patients were under fifteen years of age. The data concerning patients who were not traced or under observation have been eliminated from the discussion, since the end results were too indefinite. There were three deaths. One patient died of a fractured skull the day of the accident, two died postoperatively, one of pulmonary fat embolism, the day of the operation, and one, a woman, aged 50, died in the third week from pulmonary embolism following reduction and treatment by the Whitman method of a fracture of the neck of the femur. Necropsy disclosed a huge pulmonary embolism evidently having its origin in a thrombosis in the common iliac vein. Thus remain definite records of forty patients from which to estimate end results.

Nine patients had sustained fractures of the neck of the femur; seven were cured. One fracture was of the intertrochanteric type, and a satisfactory result was obtained. One was a frank failure owing, I believe, to improper reduction of the fracture. One patient failed to carry out the treatment.

The Whitman method of treatment was preferred, but when for some reason it could not be carried out, the Ruth Maxwell traction and counter-traction method was employed, with a certain amount of abduction. Counter-traction, an essential part of this treatment, when properly applied, raises the trochanter and rotates the foot inward. It has been our practice, regardless of the type of fixation, to break down the impaction and set the fracture as one would any broken bone. On the whole, it is probably better routinely to break up a so-called impaction of a fractured hip except when for some reason, such as old age with debility, or a systemic terminal disease, such as pernicious anemia, malignancy, or tabes dorsalis, the treatment of the fracture must be carried along on palliative lines. There is no reason why a fracture of the neck of the femur, either of the subcapital or the intertrochanteric type, should fail to unite in persons in good health, and old age is not in itself unfavorable. .

Seven patients had sustained fractures in the upper third of the femur; all obtained satisfactory results. Four were operated on and three were treated conservatively. Theoretically, owing to the slightly forward and outward displacement of the upper fragment, traction should be applied in a corresponding direction. The distance from

the symphysis pubis to the adductor tubercle on the inner condyle is increased by more than 2 cm. when the hip is in full abduction. The powerful adductor magnus must, therefore, be stretched correspondingly. I believe this is sufficient reason why traction should not be made in this manner. Lee has mentioned this recently. Straight extension is sufficient if properly applied and not used as a mere ritual.

There were fifteen fractures in the middle third of the femur, with fifteen cures. Ten patients were operated on and five were treated conservatively. A slight angulation will not so easily cause a static arthritis in this area as at either end of the bone. Sagging of the lower fragment posteriorly and laterally may occur, and care should be taken not to permit it to become too greatly displaced.

There were five fractures in the lower third, with three cures. One patient was operated on and four were treated conservatively. The lower fragment may become displaced posteriorly and the end press on the popliteal vessels and nerves. If the fracture is not readily reduced by manipulation, one should not hesitate to reduce it by operation, for if it is left but a short time, reduction even by the open method may be very difficult.

In children, the epiphysis may be separated and displaced forward. There were three fractures of this type in the series, with two satisfactory results. One of the patients who died was a boy of nine, with an epiphyseal separation. He died the first day from pulmonary embolism. There were two open operations and one closed. It is astonishing how little deformity is evident in an epiphyseal separation with forward displacement, and it is not surprising that this somewhat unusual condition is often not recognized by the general practitioner. Acute flexion of the knee, with traction and manipulation, may reduce the deformity. If the reduction is difficult and open operation is decided on, the split patellar incision gives excellent exposure and enables the surgeon to replace the epiphysis accurately. Personally, I have no hesitation in making a full exposure of the joint in this manner.

The problem of when to permit weight bearing is most important. The time varies with the type and location of the fracture and the age of the patient, but there should be a cardinal rule that patients with fractures of the femur should not be allowed to walk, when the time comes to permit weight bearing, without a Thomas caliper walking splint. The splint should be discarded only when the clinical and roentgen-ray examinations show firm union. I find that I am inclined

to lengthen the period of restricted weight bearing rather than to shorten it.

Of the forty patients, thirty-five (87.5 per cent.) were cured. Two had residual shortening and a consequent limp, and although they obtained excellent function, they are classified in the group of improved. The failures in the shaft were usually the result of bowing of the bones. This occurs even when the patient is wearing a cast. Some of the patients were permitted weight bearing without the walking caliper splint too soon, and some disregarded instructions.

Our practice now in treating recent fractures of the femur may be tersely described: The younger the patient, the easier is the application and the carrying out of conservative measures, although occasionally, even with babies, difficulty will be encountered in satisfactorily engaging the ends of the bone. When this occurs, open operation should be resorted to. In vigorous adults, under proper surroundings, the open operation, using beef-bone plates, or if necessary, metal plates, as internal fixation, in my experience at least, has been more satisfactory than conservative measures. In a well-equipped fracture ward in a hospital with trained attendants, conservative measures would, I believe, give equally good functional results, but such ideal conditions are rarely at hand. The proper internal splinting and postoperative fixation insures a perfect anatomic result. A good fracture table is essential; every hospital should have one. In elderly patients, I have been prone to resort to conservative measures, but in the future I believe I shall operate more often if patients are in good general health. This does not apply to patients with fractures of the neck of the femur, for which the Whitman abduction method gives perfect control of the fragments. Prolonged fixation in plaster tends to stiffen the knee and we are now putting joints in casts to permit early active motion of the knee.

OLD FRACTURES.

Of the 165 patients who came to us for consultation because of faulty end results, fifty had had fractures of the neck of the femur, and all but six of the fifty were operated upon. Five patients left our care too soon to show the end results. Thirty-nine of the traced patients were operated upon and twenty-eight (71.7 per cent.) were cured. In the successful cases, an autogenous bone transplant was used for nonunion in eight, beef-bone screws in eight, and metal screws or nails in four. Two patients had malunion, and osteotomy was performed.

In six, the union was delayed and plaster of Paris casts were applied. There were no deaths, although a patient operated upon recently, who was not included in the group, died three days after the operation because of cerebral embolism originating in a thrombosed common iliac vein. The thrombus passed through a patent foramen ovale, which had not caused symptoms during life. Plaster of Paris extending from the chest to the toes on the side involved, and to the knee on the opposite leg affords firm fixation. On the affected side a joint may be made in the cast at the knee so that the knee may be moved gently and stiffness be prevented.

I have not sufficient time to permit a free discussion of the type of case that should be selected for the pegging operation, and the type for the Brackett operation. I may say, however, that if absorption of the neck is practically complete and the head lies flush with the margin of the acetabulum, a bone pegging operation, no matter how carefully performed, is useless. Roentgenographs should always be taken with the foot in eversion and in inversion to show the amount of neck remaining. When a fair sized remnant of neck remains, I prefer to use the fibula as a transplant on account of its size and strength, but when there is little or no neck, I prefer the Brackett operation.

Transtrochanteric fractures and subtrochanteric fractures, as a rule, unite without any difficulty, but malunion may follow, necessitating an osteotomy. If the fragments are comminuted there may be excessive callus with some shortening, but strenuous attempts to obtain lengthening are not unattended with danger, for the muscles, nerves, vessels, and tendons may all be very much shortened. Even though there is considerable shortening, if union is firm, and the weight bearing line is satisfactory, it is my opinion that no interference should be undertaken.

In treating old fractures of the shaft of the femur, whether in the upper, middle, or lower third, the problem is much the same. An operation is difficult and may be attended with infection and risk to life. It is difficult to estimate end results in such patients because a study should be made of individual cases, and because in some it would be absolutely impossible to obtain perfect results. I have arbitrarily classified as cured patients in whom we have attained what I consider the maximum of benefit for the individual, thus making the classification a personal equation. Therefore, a discussion of some of the interesting facts I have elicited in the scrutiny and study of the histories of these patients may possibly be of more value than an attempt to tabulate results.

I was very much impressed by the fact that it is an extremely difficult matter to keep the records of patients who are under observation for some time in a manner so that an intelligent and comprehensive résumé of the patient's progress from the time he enters the hospital until he is dismissed cured, improved, unimproved, or still under observation, can be made. An editorial in the March issue of the *Journal of Orthopædic Surgery*, on the subject of reporting results in fractures, briefly states what such a report should be. But few of us can really offer such valuable data.

The metal plate was used in fifty-eight operations. In this day of autogenous bone grafting this seems rank heresy, but I must confess that in many of these old fractures of the femur, after I have made a tediously long dissection to expose the fragments, freshen them, and fit the ends, I am only too glad to fall back on the metal plates and screws as the easiest and quickest way out of a difficult position. Prolongation of the operation to apply a bone graft is attended with a risk that cannot be lightly considered. The oblique and spiral fractures may often be easily held with beef-bone screws alone, and in the transverse fractures the beef-bone plate and screws combined are in many respects ideal. Sepsis is more prone to follow the use of the metal plates than the use of the beef-bone plate or autogenous bone graft. It is now my practice to remove every metal plate as soon as union is sufficiently firm to permit its discontinuance. Infection may spoil a well conducted operation, and is a factor to be considered in dealing with end results. In the present series infection ran high and occasionally caused failure. We have classified as infections all cases in which pus discharged, regardless of whether or not it influenced the convalescence. Twenty per cent. of the clean cases became infected. In the cases in which operations had previously been performed (in many, infection had followed the primary operation), 43 per cent. developed infection afterward. I do not believe this to be the fault of our technic, but rather the type of case, for in a recent investigation of 413 autogenous bone grafts, in 247 operations for ununited fractures, infection developed in 10 per cent of the clean cases, and in 41.3 per cent. of the previously infected cases there was a discharge of pus. In the easily conducted 166 spinal transplants of the series, however, only 2.6 per cent. became infected, in spite of the fact that two large incisions were made and the motor saw employed in each case. Under a system of close checking up on the postoperative condition of wounds following general surgical operations in the Mayo Clinic,

Sistrunk finds that almost 10 per cent. of the clean cases show some degree of infection.

Whatever the means taken to hold the fragments in position, some form of postoperative fixation is essential. There are two ways to secure this: one is fixation in a cast, and the other is some form of extension. I have no hesitation in saying that to rely on the cast to hold the fragments in place in a fracture of the shaft of the femur, either recent or old, when there is any tension of the muscles and tendons, is to court disaster. Bowing may occur no matter how carefully a cast is applied, particularly if it is put on under extension on a fracture table. The only safe way is to put the patient in bed with enough extension to overcome the spasm of the powerful muscles. I prefer to apply a light cast to the thigh and a Thomas splint, elevate the foot of the bed and by a combination of weights strung over a pulley and the patient's own weight, maintain extension until the fracture is firmly enough united so that either a cast or a walking caliper may be used. In the majority of instances adults should not be permitted full weight bearing for six months following operative measures.

There were 115 fractures of the shaft of the femur. Twenty-four were in the upper third; fifty-seven in the middle third, and thirty-four in the lower third. Ninety-eight patients were traced, seventeen were not traced. Sixty-nine were operated upon by some form of open operation. In this list are the nonunions, malunions and delayed unions, with fifty-three (76.7 per cent.) satisfactory results. Twenty-nine patients were treated by conservative measures with twenty-seven (93.1 per cent.) satisfactory results. The nonoperative treatment gave a greater number of proportionately good results than the operative treatment. It must be remembered, however, that operative measures were employed for the more serious fractures, while nonoperative measures, such as manipulations under ether to line up the fragments, and treatment by extension and Thomas splints, were employed for the more simple fractures.

It is not possible to deduce the best method by statistics, but I believe that in fractures of the neck of the femur, if enough of the neck remains, the bone peg, preferably the fibula, is the method of choice, but if the neck is absorbed, the Brackett operation offers the most encouragement. In the shaft, theoretically, the bone graft, either the intramedullary, inlay, or massive, is preferable, but for practical reasons the metal plate must often be used. The beef-bone plate is supplanting the metal plate in our practice, and I believe is much better tolerated by the tissues.

One hundred and two operations were performed for old fractures with two deaths. One woman, aged 38, with nonunion of the middle third of the femur, died the day of the operation from pulmonary embolism; necropsy was not permitted. One patient, a man aged 32, died the sixth day after operation, and necropsy failed to disclose adequate cause for death. A slight broncho-pneumonia and a slightly contracted kidney were found, but no evidence of pulmonary embolism. I am inclined to believe the patient died of renal insufficiency, although clinical examination had been negative.

There are two serious complications that are of clinical significance and which stand out in this review. First, thrombosis of the common iliac artery in fractures of the neck of the femur. This is, I believe, more common than we have thought. It was demonstrated at necropsy in two of our patients dying of embolism, and probably was the cause of the persistent edema seen in some of our patients, who, as far as the fracture was concerned, obtained excellent results. Second, dilatation of the stomach. This occurs but rarely in orthopædic cases, but if it is unrecognized, may cause the death of the patient. I have often heard Dr. C. H. Mayo say that if in the surgical wards of hospitals the internes carried stomach tubes hanging about their necks instead of stethoscopes, the mortality rate would be reduced.

SUMMARY.

Fifty-five of the fractures were recent; nine were in the neck of the femur, and seven were cured. The two failures were owing, in one instance, undoubtedly to improper reduction, and in the other to the removal of the cast in three weeks and the patient's refusal of further treatment. Forty patients were observed to end results; thirty-five (87.5) had obtained entirely satisfactory results. Although I am not prepared to state, from such a small series of cases, whether open operation or conservative measures is the preferred treatment, I do not hesitate to operate on patients, providing conditions are satisfactory, if I am satisfied that the fragments are not in good position.

One hundred sixty-five of the fractures were old, or end results of fractures of the femur. It is difficult to judge the conditions under which the primary treatment was carried out, but it was undoubtedly quite inefficient in the greater number of cases. In the smaller number, union had been slow and the pull of the powerful muscles, or too early weight bearing had caused bowing. It is difficult to determine from the roentgenograms or from clinical examinations when union is

complete in a case of malunion. On opening some of the fractures of this type, motion was easily demonstrated. In fifty patients, the causes of the disability were faulty end results following fractures of the neck of the femur. Five patients were not traced and six were not operated on by the open method; the remaining thirty-nine were operated on. Osteotomy for malunion was performed in two; the others were treated for non union, and twenty-eight (71.7 per cent.) were cured. In cases in which the neck was absorbed and union was attempted by using a bone peg, failures were uniform. A fair amount of neck must remain if there is to be any chance of union. The Brackett operation is the method of choice when the neck is destroyed.

One hundred fifteen patients with fractures of the shaft were treated and ninety-eight were traced. Sixty-nine were operated on and 76.7 per cent. were cured. Twenty-nine were treated by conservative measures, and twenty-seven (93.1 per cent.) obtained satisfactory results.

End Results in Fractures of the Femur, 222 Cases.
57 Recent Fractures; 165 Old Fractures.

40 patients with recent fractures traced, 35 (87.5%) cured
10 fractures were of the neck, 8 were cured 7 fractures were of the upper third, 7 were cured 15 fractures were of the middle third, 15 were cured 5 fractures were of the lower third, 3 were cured 3 were separations of the epiphysis, 2 were cured.
2 postoperative deaths, both due to pulmonary embolism
143 patients with old fractures were traced
50 fractures were of the neck 39 were operated on, 28 (71.1%) were cured 6 were manipulated and casts applied, 6 were cured 5 patients were not traced
115 fractures were of the shaft 69 were operated on, 53 (76.7%) were cured 29 were not operated on, 27 (93.1%) were cured 17 patients were not traced.

THE TREATMENT OF FRACTURES OF THE FEMUR.

BY FRANK E. PECKHAM, M.D., PROVIDENCE, R. I.

In the treatment of fresh fractures of the femur, the mechanical principles involved are very simple, and right here it might be said that all treatment should be reduced to simplicity, which is directly away from much of the complexity which is seen in medical print in these post-bellum days.

In a fresh fracture of the femur, anywhere from top to bottom, traction and counter-traction will pull the leg down to length.

In Figure 1 (a), is illustrated a patient with extension and counter-extension applied. The extension is applied as usual, with wide adhesive straps on the sides of the leg from a point just *above* the level of the fracture. A part of the counter-extension is obtained by elevating the foot of the bed, but this is not sufficient. To obtain a sufficient amount of counter-extension a long, padded, peroneal band is adjusted on the side of the fractured leg and a pulley at the head of the bed is used for the weight. About one-half of the amount of weight on the leg is used as the counter-extension at the head of the bed. Judgment is used as to the amount of weights necessary in the individual case, depending on whether there is much or little riding by of the fragments. The constant, never-let-up traction, hour after hour, pulls the fragments down to length. The position of the fragments is established by x-ray pictures so that it is possible to gauge the position accurately. In all fractures of the shaft, the foot should be kept not only at a right angle, but in the upright position. In all fractures of the middle and upper third coaptation splints are used. They should extend the whole length of the femur. Posteriorly, sometimes, not always, a "ham splint" or a posterior wire splint is made use of.

Now and then, after a leg has been pulled down to length, the fragments refuse to go into apposition. This may be overcome by a mechanical device if the sharp ends are not caught in the soft tissues. If they are caught, then surgery is necessary, but ordinarily it is not the surgery of internal fixation. A comminuted fracture of the lower third will illustrate this condition. The fragments sagged downward when the extension and counter-extension pulled the leg down to

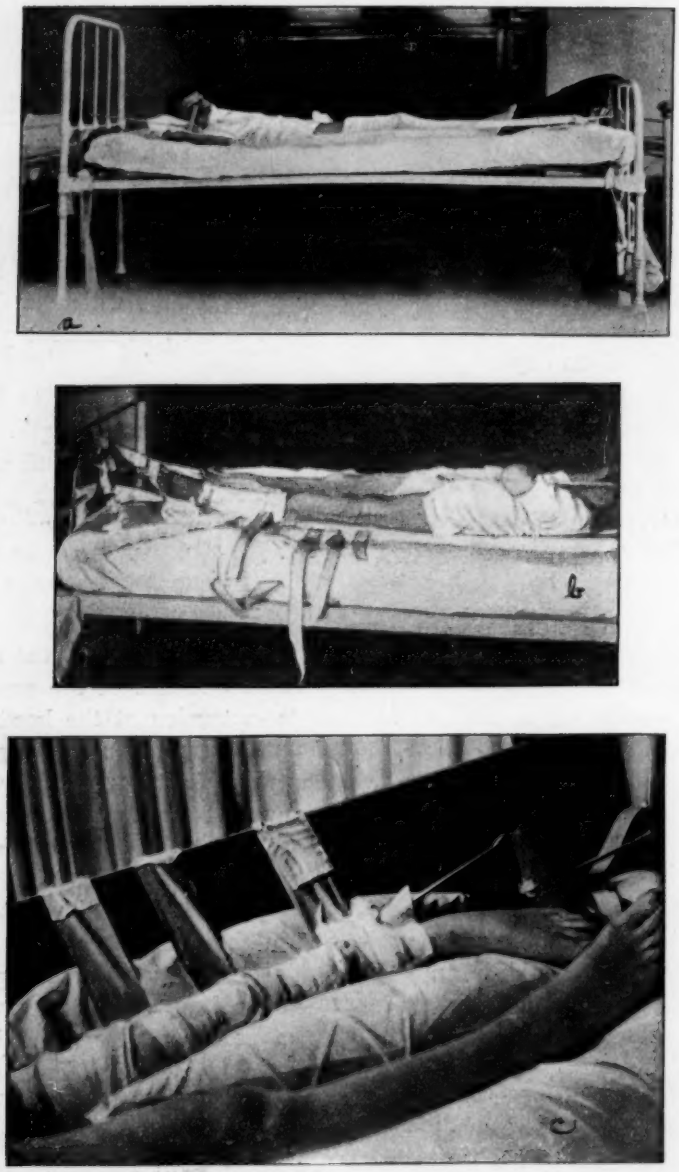


FIG. 1.—(*a*) Shows a patient in bed with extension and counter-extension applied. (*b*) Illustrates how the incision is made with the patient in bed and with extension and counter-extension in force. (*c*) Shows how the wide T splint is used in connection with the adhesive straps to produce strong internal rotation in fractures of the neck of the femur, after the leg has been pulled down to longer than "length" as proved by the x-ray.

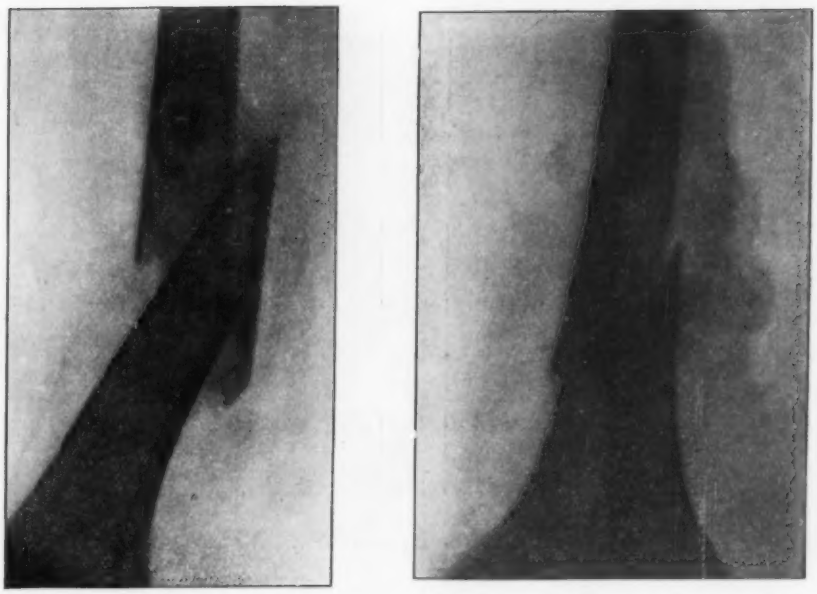


FIG. 2.—Shows fracture of lower third taken before treatment and after union had taken place.

FIG. 3*a*.—Shows the fresh fracture.

FIG. 3*b*.—The mechanics for elevation.

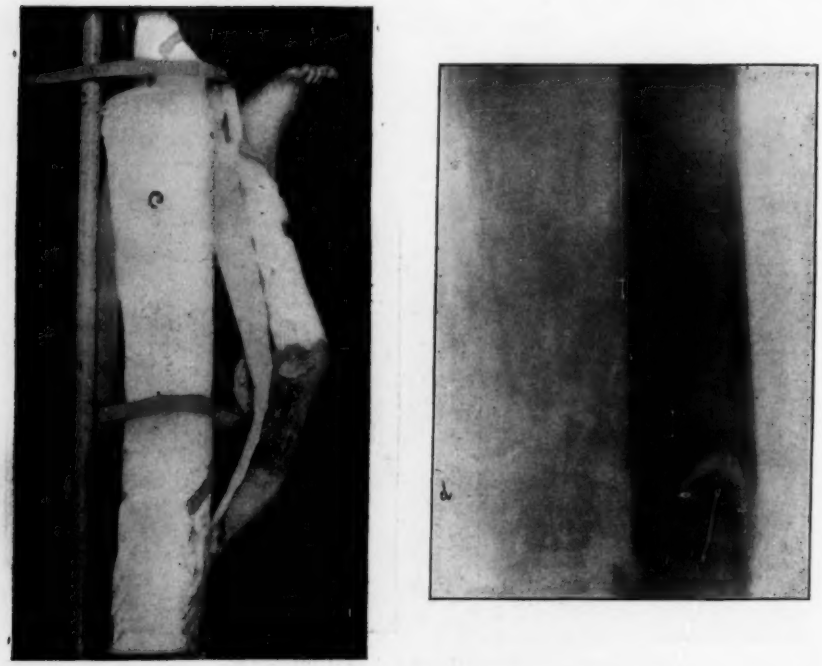


FIG. 3.—(*c*) The leg in place with proper elevation. Also shows healed incision. (*d*) Shows apposition of fragments.

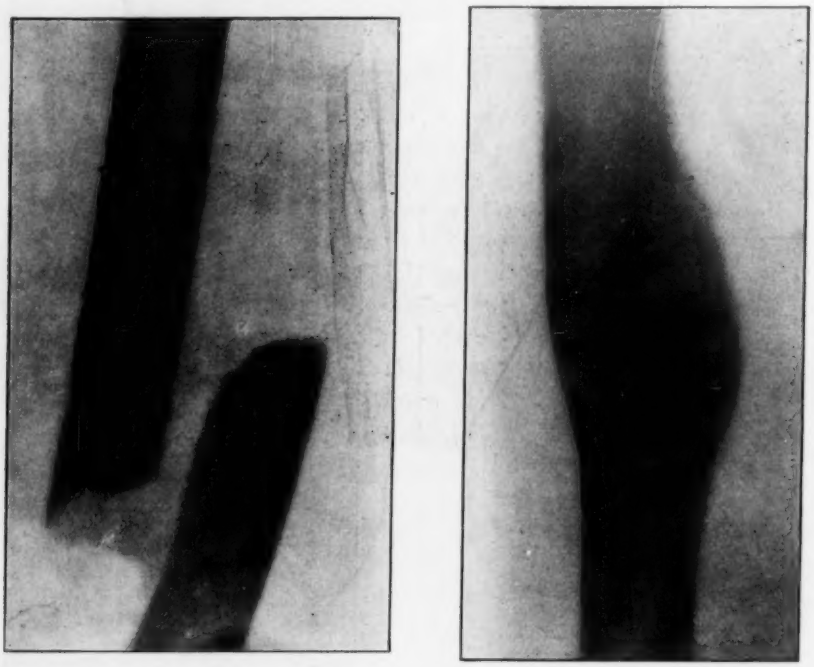


FIG. 4.—Shows a fresh fracture of the middle of the femur with the same bone after strong union had taken place.

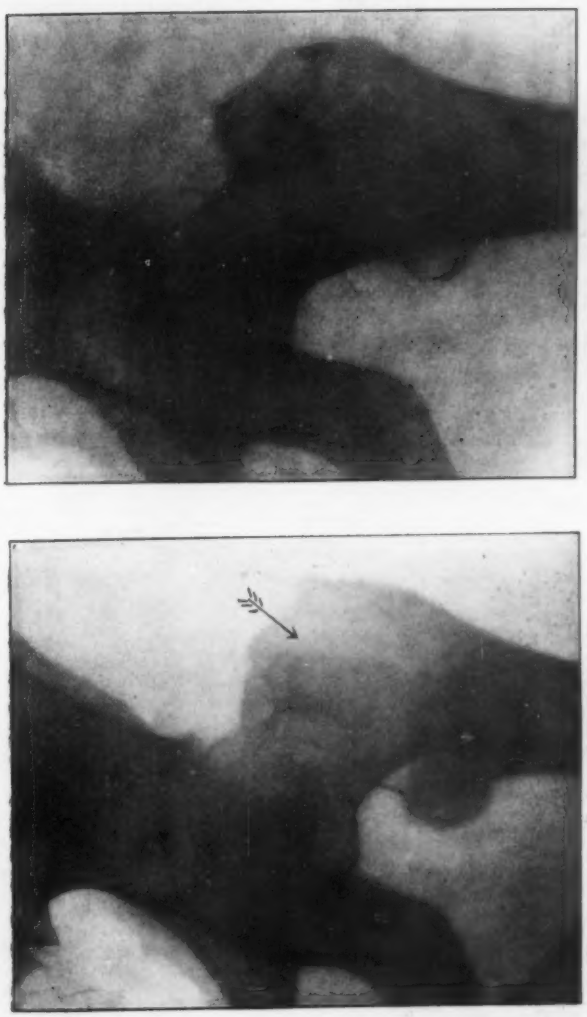


FIG. 5.—Fracture of the neck of the femur before and after reduction.

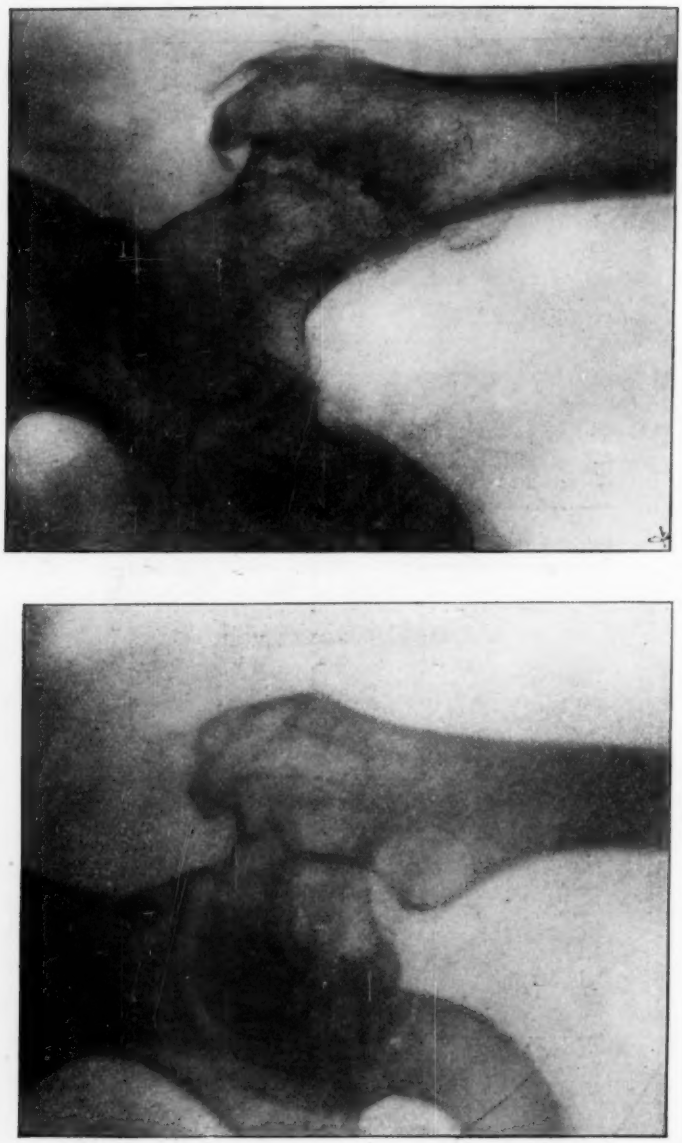


FIG. 6.—(*a*) The fresh fracture. (*b*) After setting.

Fig. 7.—(*a*) The fresh fracture. (*b*) Twelve weeks after the accident. (*c*) Possible flexion one year after.

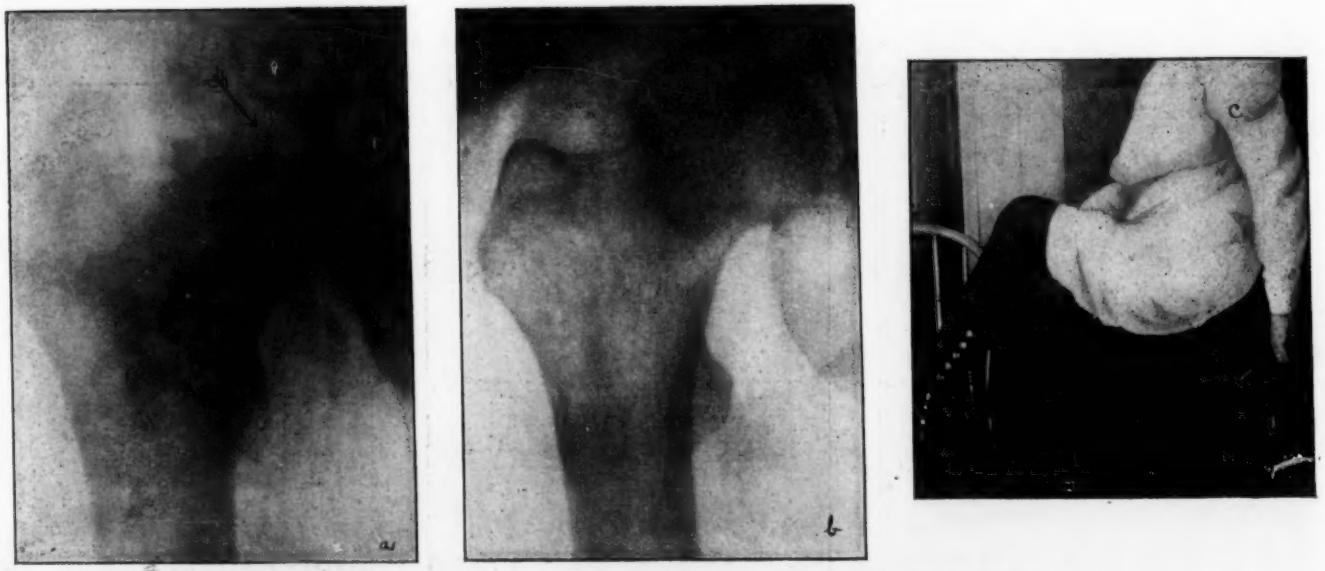


FIG. 8.—(*a*) Shows a fresh fracture of the middle of the neck of the femur. (*b*) The fracture one year later. (*c*) Shows the possible flexion one year after the accident.

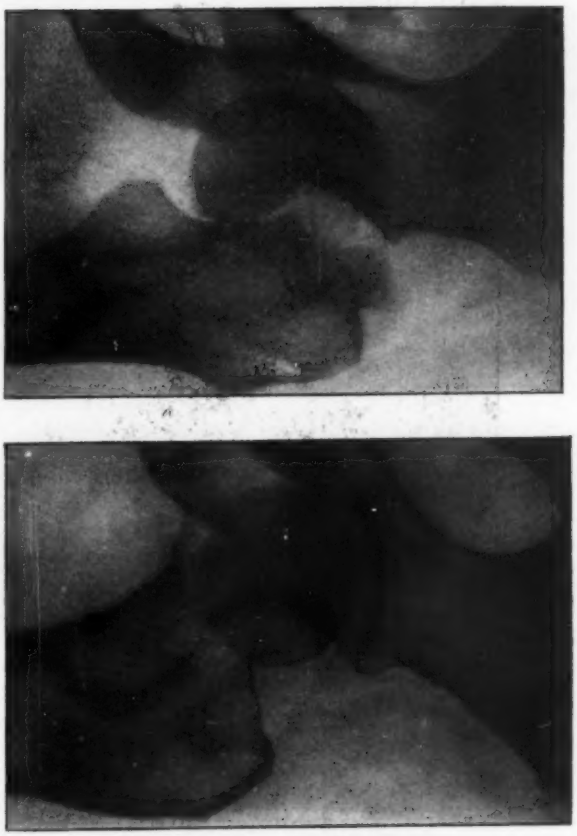


FIG. 9.—Shows a fresh fracture of the middle of the neck of the femur before and after reduction. The long fragment pulled down well under the small round short fragment.

FIG. 10.—(*a*) Shows the fresh fracture. (*b*) Shows the leg pulled down to a little longer than "length." (*d*) Shows the bone one year after the accident.

length so that they were not in apposition. In this case, a folded sheet under the point of fracture gave sufficient elevation to completely restore the alignment.

Figure 2 shows the fracture before treatment and after union had taken place.

Figure 3 (a). This fracture was pulled down by extension and counter-extension, but apposition was impossible. It was apparent that one or both fragments had caught in the muscle tissue. Here was a case for surgery, but not the internal fixation kind of surgery.

A curved splint, Figure 3 (b), was arranged underneath the leg. This splint could be raised and lowered as required. A sufficient amount of elevation was given until the x-ray picture showed the bone in a straight line but still not in apposition. The patient was then taken to the operating room in bed, with the extension and counter-extension all intact. Also the leg was on the splint as shown in Figure 3 (c). Under ether, an incision was made on the outer side of the leg at the seat of fracture. The short fragment was found stuck in the soft structures. After it was disengaged, the fragments easily went into apposition, Figure 3 (d). The mechanics, the patient, the leg, nothing was disturbed from its fixed position either by ether or the operation. The wound was closed and union was uninterrupted.

Figure 3 (e) shows the healed incision the day the stitches were removed.

Figure 3 (d) shows the apposition of the fragments.

Cases of simple fracture of the middle of the femur reduced by extension and counter-extension have been shown in former papers before this Society, so that only one case will be published where extension and counter-extension pulled the leg down to length but the ends still remained separated. The pulls were arranged as in Figure 1 (a) and (b), and the patient sent to the operating room in bed with the various extensions intact. Under ether, incision was made as illustrated in Figure 1 (b). The fragments were found caught in the soft structures. When they were disengaged, the ends went into contact in fairly good apposition. The wound was closed, the mechanics not having been disturbed in any way. The treatment in this way was reduced to that of a simple fracture again. The surgery was entirely secondary to the mechanical treatment, no internal fixation being necessary.

Figure 4 shows the fracture before treatment and after union had taken place and the boy walking on it. In very oblique fractures the

ends may be so shaped that one end will dovetail into the other, thus holding firmly without any internal fixation.

In fractures of the neck of the femur, extension and counter-extension are also used to get the leg not only down to length but just a little *longer,* as will be shown in the actual cases. The time required may be only two or three days in some of the easy cases, or may require ten days or two weeks in others. Not later than two weeks, the fragments must be in perfect apposition. After the leg is down to a little longer than length, as actually demonstrated by x-ray pictures, perfect apposition is obtained by strong internal rotation. This is accomplished as illustrated in Figure 1 (c). A T splint is placed in position extending from the axilla to the foot of the bed, so that it is well fixed in position. This T splint is quite wide, so that it extends well above the level of the leg. Then the adhesive straps, usually three, are placed around the leg in such a manner that when brought up over the wide T splint they strongly internally rotate the leg. This brings the fragments into absolute contact and exactly end to end. This must also be absolutely demonstrated by the x-ray and the mechanics "played with" until the contact is perfect.

A few cases will suffice to show the results of such mechanics if properly applied.

Mrs. G. Age, 48. Figure 5 (a)—The fresh fracture. Figure 5 (b) —The fracture after setting. Observe the way the leg is pulled down to longer than "length" and the excellent "valgus" angle of the neck with the shaft.

Mrs. McG. Age, 42. Figure 6 (a)—Shows the fresh fracture. Figure 6 (b)—The fracture after setting. Observe the "valgus" angle of the neck with the shaft.

Mrs. S. Age, 64. Figure 7 (a)—Shows the fresh fracture. Figure 7 (b)—The fracture twelve weeks afterwards. Observe the "valgus" angle of the neck with the shaft. Figure 7 (c)—Shows the possible flexion one year after the accident.

Mrs. C. Age, about 50. Figure 8 (a)—Shows a fresh fracture of the middle of the neck of the femur. Figure 8 (b)—The same fracture one year later. Observe that the leg was pulled down so that the long fragment was *under* the short fragment, which amounts to a round ball of bone in some cases. Figure 8 (c)—Shows the possible flexion one year after the accident.

Miss R. Age. 70. Figure 9 (a)—Shows a fresh fracture of the middle of the neck of the femur. Figure 9 (b)—Shows the reduction

with the long fragment pulled down so that it is decidedly *under* the small, round, short fragment.

Mrs. C. Figure 10 (a)—Shows a fresh fracture of the middle of the neck of the femur. Figure 10 (b)—Shows the leg pulled down to a little *longer* than "langth," with the bone well *under* the short, round fragment. Figure 10 (d)—Shows the bone one year after the accident.

Having the long fragment in these cases pulled well down, so that it is not on the level with but well *under* the short, round fragment, has been emphasized in this paper. It is important because when union has taken place, the body weight pushing downward does not make so much a cross strain but more in the longitudinal direction of the bone. This position is insurance against shortening which may take place even with seemingly good union, if the neck is in a "varus" position. I cannot find that this point in the mechanics has been previously mentioned in literature.

With this method of treatment the whole thing is done gradually. Neither ether nor plaster of Paris is necessary. Every square inch of the body may be bathed and cared for. If necessity arises, the patient may be bolstered up in bed 45 or 50 degrees. A lady 75 years of age has just been successfully taken through this treatment while up in bed at an angle of about 60 degrees. The union as shown by the x-ray is perfect and she is beginning to walk on the leg.

This case may be matched up with another lady, aged 75, where there was no callus formation whatever. It was very interesting though to observe with what ease the fragments could be kept in perfect position for weeks (proved by frequent x-rays) without any union.

Another patient, around 70 (?) years of age, after there was beginning union, took off all apparatus and was found sitting in a chair when the House Officer appeared on his morning rounds. This was the first patient, however, to do this, but I have had two cases within a year (including the one above mentioned) of no callus formation whatever. There was one other case where union was delayed until about four months, but finally it was all right.

Regarding the so-called setting or getting the fragments into perfect apposition, so far, it has *always* been possible to do it in the way described and illustrated.

Trouble could only arise from calcium deficiency causing delayed union, or entire lack of union, and, as in the one case mentioned, a refractory patient.

END-RESUTS IN FRACTURES OF THE KNEE AND ANKLE.

BY DR. G. W. HAWLEY, BRIDGEPORT, CONN.

THE English writer, Chesterton, has recently said that facts are one thing, but the truth quite another. It is easy to assemble facts, but it is difficult to extract the principles of truth. This is true of the end-results of surgical treatment because of the present limitations of surgical therapeutics and because reports deal with the known and not the unknown facts. Sir Berkeley Moynihan puts it very clearly when he says that the surgical ritual begins with the early treatment but does not end until the patient is restored to health. In most surgical institutions the ritual of treatment ends with the anatomical, not the functional recovery, and most hospitals are better informed regarding results when the patient leaves the hospital and not with the final return of the patient to health. The era of abdominal surgery of the last twenty-five years with its record of achievement, accounts in part for the incompleteness of surgical treatment, because it has been chiefly absorbed in the perfection of surgical technique and the development of the ritual of operations. Moreover, surgical treatment has been based on anatomy, and operations have been performed to correct form only. This has been true of fracture surgery. The worship of form is natural, because defect of form is obvious. It is easier to ascribe disability to defect of form, than to prove it, and it is easier to treat deformity than disability. Today, surgery is assuming more and more of a biological basis, and treatment is being carried out, consciously and unconsciously, on the scientific study of the relation of deformity to disability. No longer are operations systematically undertaken to correct architectural defects alone, and the history of pelvic surgery is suggestive of the future.

So far, the statistics published regarding fracture results represent but a small fraction of all the fractures occurring every year. The text-books offer little information, and the efforts of the fracture commissions of the British Medical Association and the American Surgical Association have not produced reports sufficiently complete to be conclusive.

The determination of fracture results is difficult because, unlike abdominal and other branches of surgery, there is no standard system of treatment, no standard interpretation of the principles of treatment, no standard measure of the function of a limb as a motor and no

standard measure of the effect of the fracture deformity on function.

It is not the purpose of this paper to present an imperfect report of cases covering a long period. Instead, I have taken the liberty of confining this report to cases treated during the last two years, in which the treatment has been carried out and the results measured according to a definite code, however imperfect that code may be.

The remark is frequently made that this is an age of change, and someone has added that change is the only unchanging thing in the world after all. In the treatment of more than six thousand fractures during the last fifteen years, exclusive of war fractures, my views regarding fracture treatment have undergone gradual change and these changes must be taken into consideration in the report of the cases herewith submitted. In order to explain these changes, it will be necessary for me to define in some detail the code which I have attempted to formulate as a guide to the treatment of any and all fractures. I trust I may be pardoned for repeating many time-honored and obvious truths.

1. The treatment of a fracture is not the treatment of a broken bone, but of a motor with a broken part.

2. Restoration of function is more important than restoration of form.

3. The treatment of a fracture is the treatment of a disability, not deformity.

4. The treatment of a fracture as a deformity only is a sterile ritual of form. If it were not for the fact that deformity often causes disability there would be no reason to correct deformity except for appearance only.

5. The treatment of a fracture deformity, except for cosmetic effect, depends upon the relation of the deformity to disability, for there are deformities without disability and slight deformities with great disability.

6. By reduction is meant the correction of a fracture deformity, when a deformity requiring correction exists.

7. By immobilization is meant the immobilization of the broken ends of a bone, not the motor apparatus. Immobilization has but one purpose, the prevention of deformity, and it is always imperfect, never complete. All fractures, treated and untreated, consolidate, and those ununited after five or ten years are the rare exceptions which prove the rule. Immobilization is unphysiological except when strictly limited to the pathological necessity, and the necessity in fracture is very different from the necessity in tuberculosis. Immobilization is an un-

fortunate necessity in fractures because of the technical difficulties of securing necessary fixation of the broken part without unnecessary fixation of much or all of the injured motor. Immobilization of the motor apparatus inflicts temporary or permanent damage. It is easily overdone and made an empirical formality because of the imperfect methods of fixation and because of the difficulty of determining when the necessity exists and when it ends.

8. By mobilization is not meant mobilization of broken bone ends, but mobilization of the motor apparatus. Lucas-Championière was right in insisting on the value of mobilization, but the distinction must be made between avoidable and unavoidable deformities and those with and without disability. There is no conflict between the so-called mobilization and immobilization treatment. The two go hand in hand, and improvement in fracture treatment depends very much on the development of methods which effectively combine mobilization of the motor and fixation of the fracture.

9. The term manipulation is a term of disguise unless defined in definite physiological terms. Otherwise, it has the same unscientific meaning given it by old-fashioned and the modern bone-setters.

10. There are only two forces, traction and leverage, which may be utilized to correct fracture displacement. Of these, traction is the force most effective in the reduction of fractures of the long bones where the two pieces possess length, and leverage of the fractures when one fragment is long and the other short.

11. The mechanical treatment of fractures is not a mechanical, but a physiological problem. The skeleton is not a piece of stationary furniture on which to apply the ancient art of cabinet making, nor is it an internal combustion engine. It is a self-repairing machine whose powers of repair are little understood.

12. The treatment of fractures as a physiological problem involves the study of an arm or leg as a motor, the study of fracture deformity and its relation to disability, the study of the correction of deformity, the study of fracture repair, the study of motor repair, and the study of permanent disability.

13. The treatment of an injured limb necessitates an understanding of the operation of the limb as a machine. It takes years to develop ordinary function and special training to develop specialized function, as every skilled artisan knows, but it takes little time and little damage to impair for a longer or shorter period what has taken a long time to acquire. The action of individual muscles and joints has been described, but this does not explain the operation of the hand

of an engraver or the potential biological weakness of the shoulder as a motor.

14. The intelligent treatment of fractures depends on the scientific application of the relationship of deformity to disability, for it is unscientific to employ the same efforts to correct a non-disabling, as a disabling deformity. Some day the surgeon and the layman may substitute the worship of function for the worship of form, and acknowledge that an architectural defect in a bone, unless unsightly, is of no more importance than similar defects of other organs, provided it functions properly. The word shortening loses its terrifying meaning unless accompanied with disability.

15. The correction of fracture deformity and the fixation of corrected deformity involves the use of force, posture, and apparatus, but to use mechanical methods in a machine-like way, to apply plaster as a matter of form, to employ traction with no standard of form, or test of efficiency, it not good surgical practice. Too often is the test made on appearance only, just as the aeroplane splint is used without the appreciation of the imperfect control, and the resulting rotation deformity, of the scapula.

16. The process of fracture repair is a nutritional problem, localized in the damaged bone. Nature is extravagant in the normal and pathological calcium flux, and excessive deposit is the rule in bone injury and bone disease. Fractures consolidate in the presence of constitutional disease and in presence of local bone disease quite in the ordinary way. Surgical fractures in rickets and pathological fractures in carcinoma and tabes are no exceptions, and the same is probably true of fractures in lues. Fracture repair, whether hastened or delayed, depends on the revascularization of the injured bone and this in turn depends on the damage to the nutrient end-artery, the periosteum which acts as a vascular bridge for the countless vessels which pass from the soft parts to the bone, and the supply of the nutritional fluid to the limb. Delayed repair is due primarily to delayed revascularization.

17. Motor repair involves the study of the pathological as well as the normal function of muscles. When a bone is fractured normal function ceases and the pathological function begins. So-called muscle balance does not exist in the pathological state where individual muscles assume the power of permanent contraction. Motor repair involves the control of pathological function and the reëstablishment of normal function. The control of pathological function is graphically described by Sir Robert Jones when he says that the splinting prop-

erty of muscles is abolished when the artificial surgical substitute is sufficient to relieve nature of the necessity of splinting, and only then. This provides an accurate test of the efficiency of artificial splinting. When traction is inefficient pathological function continues, but when efficient the muscles automatically relax into the state of normal rest. The early or the late reëstablishment of normal function indicates the difference between the preservation and the restoration of function.

18. The study of established fracture disability involves a determination of the functional capacity of the damaged motor and the relation of structural change to functional loss. Measurements of length and range of motion mean little to the skilled workman. It is very much the same to such a man after long immobilization of the leg for fracture, as if the motor tract between his brain and leg had been cut. He is like a child learning to walk and he does not need to be told the definition of the term reëducation. Something more than the tests of primitive motion is needed and the distinction should be made between ordinary and specialized function. The surgeon is not always the best judge of surgical treatment. The best judge of the repair of a machine is not the man who does the work but the owner who drives the machine.

19. The term reconstruction treatment is used to include both the restoration of form and the restoration of function. It would be better if the two were more clearly defined because function may be preserved or restored but it cannot be reconstructed. The term came to life during the war, but no one who has seen anything of war fractures is blind to the fact that if early constructive treatment had been possible, most of the late reconstructive treatment would be unnecessary. If the war has taught anything, it has taught that reconstructive treatment should be used to prevent, rather than correct, disability.

20. Active motion is the most effective agent to preserve function and promote repair. All others are auxiliary agents. Active motion is the only means of preserving the combined and organized motor-nerve-group-muscle action. Every machine must run on its own power and no substitute can take its place. The application of active motion in an injured motor is not a simple problem. To direct a patient to move his limb accomplishes little. This explains in part the frequent failure of the application of the Willems' treatment of septic joints. There is a great difference between active motion under pathological, and under normal conditions. In every injured limb the pathological state establishes limitations of physiological action and the

appreciation of the limitations imposed is the guide to the application of active motion. This must be carried out within the pathological limitations, which are frequently narrow, but to ignore these limitations is to invite defeat through the automatic inhibitory control, and this control is absolute. The object of active motion is not mechanical but physiological, and a little motion produces the desired effect. This is often difficult unless passive motion is used to assist active motion and the active motion is gravity-free. Fracture consolidation is hastened by active motion, and the natural powers of fracture repair have not yet been fully tested.

21. Massage and passive motion, or their mechanical equivalents, are poor artificial substitutes, but valuable contributing agents, when used to aid or coach active motion. Passive motion alone is unphysiological, because it reverses joint leverage and muscle action. One machine operates the other backwards and without much benefit to either. Passive motion alone establishes a combat because one machine opposes the other, and it is only necessary to inflict pain to intensify the opposition. Passive motion has but one object, joint motion, and this it accomplishes against physiological and psychological odds. Only when used in conjunction with active motion is this antagonism overcome and it is more naturally overcome when passive motion is carried out by the patient.

Massage is a valuable agent when it is done by one trained in the sick room and not in a gymnasium, but it is feeble in comparison with active motion to prevent agglutination of gliding surfaces, preserve elasticity, remove exudate, and promote repair. The active contraction of muscles is one of the best methods of drainage and without the auxiliary booster or pump action of the muscles the flow of the nutritional fluid in a limb is always deficient.

The cases herewith reported include 19 fractures of the knee and 38 of the ankle. Of the 19 knee cases, 10 are fractures of the patella, three of the femur and six of the tibia. The ankle cases include one epiphyseal fracture with deformity, four fractures of the posterior angle of the tibia, four Pott's fracture with posterior dislocation of the astragalus, 12 with lateral displacement, and 17 without displacement.

SUMMARY OF CASES.

Of the ten patella fractures all were submitted to operation on the first to the fourth day. Immobilization of the fracture was secured by wire. There was no external splinting. Active motion (gravity-free) assisted by passive motion was begun on the fourth day. Walk-

ing was begun on the eighth day with the aid of a cane only. Ninety degrees of active motion was obtained in eight to fifteen days. Two subjects returned to work in four weeks, six in five to eight weeks, and two in ten weeks.

Of the fractures of the femur extending into the knee-joint, two were oblique fractures of the internal condyle with little displacement and one a T fracture of the condyles with telescoping of the shaft of the femur downward. The former were given hammock suspension in a Thomas splint without traction and massage with gravity-free active motion for six weeks, followed by gradual weight-bearing and full motion and power in ten weeks. In the other case, partial correction of the extensive fracture displacement was obtained by the use of the Watkin-Williams calipers in a Thomas splint with a Pearson leg-piece. Active motion throughout treatment. Operation for removal of projecting femoral shaft just above patella after four weeks, and weight-bearing after sixth week. Full recovery and return to work as steeplejack eight months after injury.

The six fractures of the head of the tibia included four of the inner tuberosity, a V fracture involving both tuberosities, and one spiral fracture of the upper shaft with fissures through the joint surface. In all but the last there was little architectural deformity and hammock suspension combined with active motion was employed, and weight-bearing begun at the end of the fourth week. In three of these cases there was complete recovery with restoration of motion and function in eight to ten weeks. In two subjects over sixty years of age with preëxisting osteoarthritis there was limitation of motion and considerable loss of function.

In the case of the epiphyseal separation of the lower end of the tibia there was wide lateral displacement of the lower fragment with an oblique fracture of the inferior end of the shaft. This deformity was completely corrected without difficulty and the leg immobilized in a Delbet plate splint which allows mobilization of the knee and ankle. Active motion of the leg muscles and joints throughout treatment. Immobilization removed at the end of two weeks. Recovery with preservation of joint motion and motor power in six weeks.

Of the four fractures of the postero-inferior angle of the tibia there was marked upward displacement of the lesser fragment with the body of the astragalus in all. In two cases complete restoration of the normal joint architecture was secured after the method of Sir Percival Pott with the patient under a general anesthetic and the foot and ankle immobilized in plaster with the gastrocnemius tendon fully

stretched. The plaster was removed in two weeks, when active motion with the auxiliary agents was instituted followed by weight-bearing after four weeks. Recovery in one case in six weeks and incomplete recovery in the case of an obese woman fifty-six years of age, with pre-existing flat feet and chronic nephritis with oedema.

In the two other of the Cotton type of fracture in which slight deformity is associated with marked secondary disability, all attempts at external correction failed and the correction of the joint architecture was accomplished by nailing the small fragment in place through a posterior incision with no external immobilization. Active motion was started on the fourth day and weight-bearing at the end of three weeks. Complete recovery in one case in five weeks and the other nine weeks.

The four cases of Pott's fracture with complete backward displacement of the astragalus were reduced after Pott's original procedure with the knee flexed on the abdomen and the gastrocnemius muscle fully relaxed, followed by immobilization in Delbet plaster splints and the foot held in dorsal flexion by a loop of muslin bandage. Active motion of ankle-joint and leg muscles by temporary release of the muslin loop carried out from the beginning. Immobilization removed in two weeks. Foot held in abduction by adhesive straps. Weight-bearing end of three weeks. Recovery in one case in four weeks, in two six weeks, and incomplete recovery in man of sixty-nine years, with moderate widening of the ankle mortise.

Of the twelve Pott's fractures with frank widening of the mortise of the ankle all were immobilized in Delbet plaster splints with the leg in the Pott's position and no attempt made to treat the deformity or the fracture, but the disability. The Delbet splints were carefully moulded to hold the mortise tight, with pressure made on the outer side of the os calcis to hold the astragalus from displacement outward. Dorsal flexion at the foot and active motion carried out as described above. Plaster removed on the eighth, tenth or fourteenth day. Recovery in eight cases three to four weeks, in three cases six to eight weeks, with moderate disability continuing in one.

Of the seventeen cases of fracture of the lower end of the fibula without rupture of the inferior tibio-fibular ligament and with the mortise tight, but potentially weakened, artificial lateral ligaments by means of three-ply adhesive straps applied on each side of the leg with the foot adducted were used and active motion with massage and weight-bearing, carried out throughout the treatment. Full recovery in three to six weeks.

THE TREATMENT OF SPRAIN-FRACTURE OF THE TUBERCLE OF THE TIBIA IN ADOLESCENCE (OSGOOD-SCHLATTER DISEASE).

BY DR. ROBERT E. SOULE, NEWARK, N. J.

THE purpose of this paper is to record a method of treatment for fracture sprain of the adolescent tibial tubercle which in my experience has proved most satisfactory.

With our present-day aids to diagnosis there should be no difficulty in the differentiation of this lesion from other affections of the knee joint. Usually there is a definite history of trauma, either direct or indirect, through striking the knee or through a sudden violent strain of the quadriceps muscle, such force causing the separation of fibres of the patellar tendon at its attachment to the upper diaphysis of the tibia and the tibial tubercle, which in adolescence is usually a beak-like projection from the upper epiphysis, overlapping the upper end of diaphysis in its anterior portion, and is separated from the diaphysis by cartilage.

The direct fibres of the patellar ligament are attached to this beak-like projection of the epiphysis, and, in addition, radiating tendon fibres are traced in a fan shaped distribution to either side attached to the tibial diaphysis. From this fan shaped distribution of the patellar tendon fibres it can be understood why the force applied does not produce a total inability of extension of the injured leg. In all cases there is some power of extension following such an injury, though this ability is greatly reduced and painful. This maintenance of partial ability to extend the leg following this injury is attributed to the remaining unruptured tendon fibres or to the sprain or partial fracture of this tibial beak only.

The local swelling is attributed to the increase of bursal fluid set up by the trauma to the bursa lying between the ligament and the tubercle, plus the infiltration resulting from the tearing of ligament fibres and direct tissue damage. One should not be misled in examining roentgenograms of both knees showing what at first glance would appear to be a like condition of both tibiae. A closer examination will show the thickened overlying soft parts and most frequently small shadows of bone density separated from the beak, also a hollow in the anterior surface of the beak, believed to be the bed from which the particles of bone have become separated. It is possible to have the same disability in both knees. Such a case came under my observation.

A boy about 13 years of age, while holding to the rear of a horse-drawn sled and sliding along on his shoes over the slippery road, allowed his feet to reach too far under the rear of the sled so that in his attempt to recover control his knees caught under the body of the sled, severely tramatizing both knees. I saw him several months after the accident and noted the enlargements over both tibial tubercles, and although he had great difficulty in going up and down stairs, he could walk fairly well on a level surface and some local tenderness was complained of in both knees.

Another case, a girl of 13 years of age, while at school fell and injured her knee. This case came under my observation shortly after the injury. Appropriate strapping was applied and the leg and thigh held in extension in a plaster of Paris cast, followed by massage and graduated mobility of the knee after a reasonable period following cessation of acute symptoms. The partial disability and some local tenderness persisted after several months' time, when the case passed from my observation, which disability might persist permanently or until final union of the tubercle and tibia would take place.

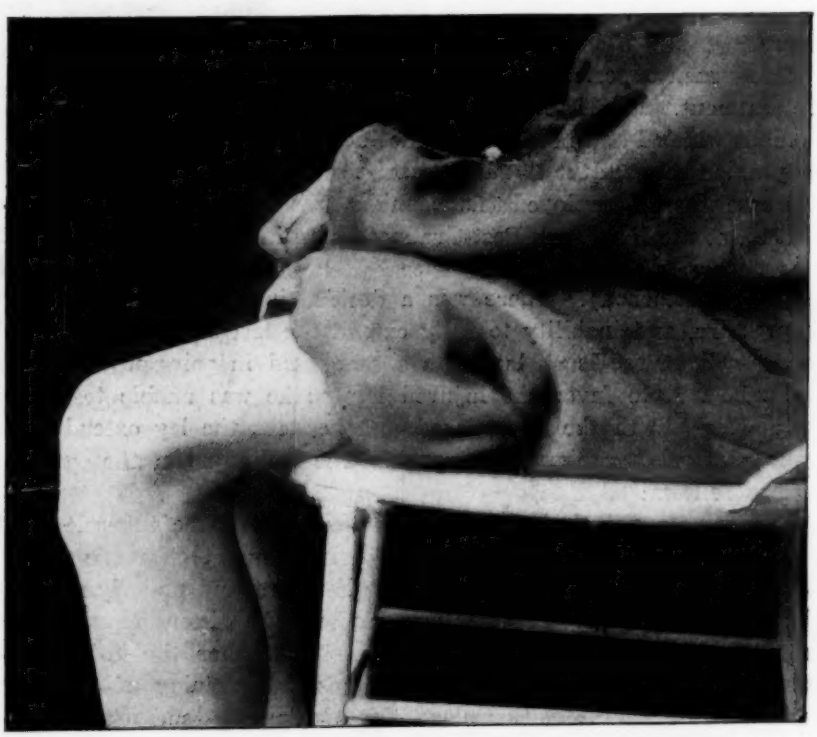
A few such experiences led me to consider more satisfactory methods of treatment. Having had gratifying results following bone pin graft methods which I had been using, I decided to attempt to stimulate early bony union between the tibial beak and the diaphysis by this means. The first case where I employed this technique was operated upon on October 3, 1915, at the New York Post-Graduate Hospital, T. G., a boy, aged 14 years, whose disability of left knee had extended over a year (see illustration attached). There was a decided local swelling, tenderness to pressure, and inability to fully extend the left leg. He could walk fairly well on the level, but with a limp, and in going up and down stairs he had to favor the injured leg, as he was unable to lift the body weight with the knee flexed and he kept the leg extended and pulled it up after him, so to speak. The technique of the operation was as follows:

Through an elliptical skin incision the area of the tubercle of the tibia was exposed. A longitudinal incision was then made directly over the tubercle, through the patellar ligament and underlying bursa. When the latter was opened it was shown to be distended with translucent gelatinous material which popped out when the knife passed through to its interior. There was marked thickening of the bursal wall and evident infiltration about this area in the tendon attachment. The bursa was excised and the tubercle drilled, the drill passing into

the diaphysis of the tibia sufficiently to securely hold the bone pin, which was shaped from a segment of the antero-internal surface of the tibia to exactly fit the hole drilled. The pin was introduced and the excess trimmed off. The skin was closed by continuous catgut suture, dressing applied and a plaster of Paris cast fitted with leg in extension.

The patient was up in a wheel chair in a week, walking with crutches in two weeks, and in six weeks he was free from all discomfort, with free use of the knee-joint. I observed this case for about a year and there was no return of pain or disability.

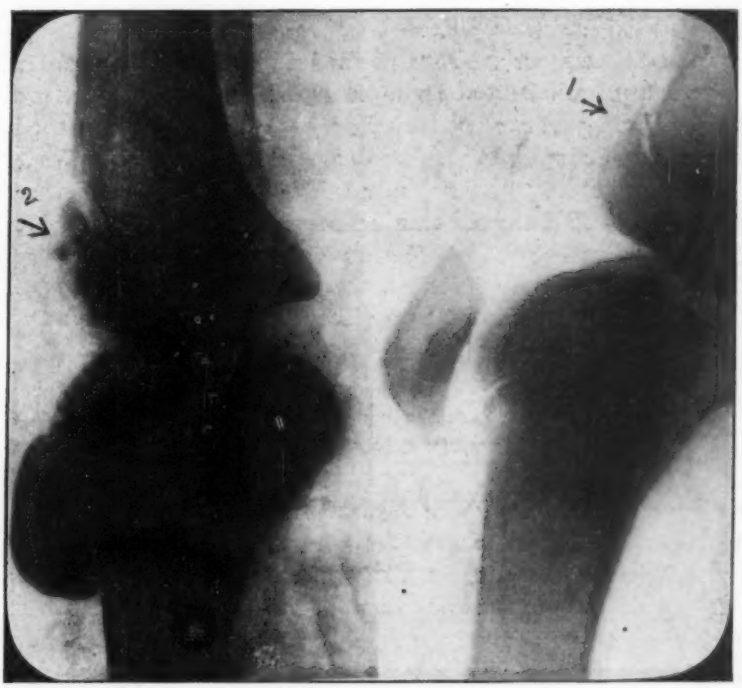
The next two cases were both adults who were inducted into military service and sent to Camp Meade, Md. Both of these men had their injuries in adolescence and roentgenograms showed detached portions of the tubercles. I operated on both, hoping to produce more stability of the knee-joint. Before they were ready for discharge, I was ordered to Fox Hills General Hospital 41, so I am unable to report more than a few weeks' postoperative observation of these two cases. They were both up and walking when I left. In one I judged the knee-



THE ABOVE PHOTOGRAPH WAS TAKEN BEFORE OPERATION AND SHOWS CLEARLY THE ABNORMAL PROMINENCE OVER THE TIBIAL TUBERCLE WHICH SWELLING IS PARTLY ACCOUNTED FOR BY THE BURSAL ENLARGEMENT.

joint was improved in stability, but my opinion is that after such a lapse of time following the injury and with permanent changes in the functions of the knee-joint, it could hardly be expected to alter the condition very much.

The fourth case I operated on by the bone pin graft method was that of a girl—M. G., aged 13 years, who several months earlier, fell and struck her right knee against the curb. She was under conservative treatment by her local physician, who referred the case to me. Examination January 19, 1920, showed the local tenderness and swelling with limp and inability to fully extend the right leg or walk up and down stairs in a normal manner. The roentgenograms verified my findings and as ample time had elapsed under the usually prescribed method of treatment without relief, I advised this operation. I did not see the case again until March, 1920, when I was asked to operate. March 3, 1920, I operated by the pin graft method, following out the after-care as mentioned above, and to date she has been free from all symptoms and disability.



THE ABOVE PHOTOGRAPH WAS MADE FROM A LANTERN SLIDE OF X-RAY PLATES OF THE FOURTH CASE OPERATED BY THE AUTOGENOUS PIN GRAFT METHOD.
(1) The tubercle before operation. (2) The tubercle after operation.

I do not offer this method as the method to be employed in all cases having this particular disability, but I do feel from the experience I have had in attempting to restore certain cases by the usual means that they do not always produce the desired result and that in the properly selected cases in adolescence the use of this method should produce the desired result, as it has for me in the two adolescent cases I have cited.

I have learned that fixation of the beak of the tibial epiphysis to the tibia has been done before by using a foreign material, but as introduction of foreign material has its objectionable features, I prefer, where possible, to use the autogenous graft.

The short period to a cure is an important factor to operator and patient, and this method would seem more definite and accurate when properly applied, though I realize that it should hardly be judged conclusively from the limited number of cases reported: still I offer it as an improvement on the inaccurate and uncertain methods heretofore employed.

AN ANALYSIS OF SEVENTEEN FRACTURES OF THE NECK OF THE FEMUR.

BY Z. B. ADAMS, M.D., BOSTON.

THIS is a fracture of old men and women. This list contains 13 women whose ages ranged from 48 to 84. The injury is usually caused by a fall on the floor.

There is no class of fractures which requires better judgment in the choice of treatment. What shall be done? How much with safety can be done? The fractures were described as mushroomed, 1; impacted, 5; intertrochanteric, 5; oblique, 1; transverse, 1; simple, 3; comminuted, 2; intra-capsular, 4; inter-capsular, 3.

Reduction was attempted in only 10 of the 17, spinal novocaine was used in five cases, ether in four. Brackett operation was done in one case. Whitman operation for reduction in eight. Held in plaster in seven cases; In Hodgen's splint suspension in one; Maxwell-Ruth in one. The Whitman plasters were suspended in Balkan frames. In no case was Campbell's very excellent method of getting the patient out of bed onto a high chair practised. This is difficult to accomplish in a large general hospital.

The two facts at times not recognized in these fractures are that (1) some of those at first firmly impacted become loose from an absorption of poorly nourished comminuted fragments; (2) the inter- and intra-capsular types unite slowly because the nutrition has been removed from the proximal fragment and this line of fracture is bathed in joint fluid.

The bed treatment was from seven to fourteen weeks with a few additional weeks in getting the patient out of bed and walking first with a walking chair, then with a Bradford abduction caliper splint and crutch, which treatment is continued for a year, gradually increasing this weight put on the line of fracture, which is always at a mechanical disadvantage even when abduction is maintained.

Results: Anatomical—Good, 7; fair, 5; bad, 4. Functional—Good, 8; fair, 5; bad, 4. Too early, 1; 2 paralyzed before fall. One case was three months old when admitted. One death from pneumonia. Shortening is from 1 cm. to 5 cm. The most frequent limitation to motion is loss of full flexion and much limitation of inward rotation.

DISCUSSION ON FRACTURE SYMPOSIUM

DR. JOEL E. GOLDTHWAIT, Boston: It is hard to know just how to approach the discussion of a series of papers like this, because it is probable that a group of men, trained as the members of this Association should be, can pass judgment upon the merits of these papers quite as well as I. It seems to me that perhaps my function, in a time like this, is to play the rôle of the old man—since I believe I am an Emeritus member of the Association—and suggest lines of caution.

The thing that we should keep constantly in mind, and that those who prepared the programme evidently had in mind, is that we are being judged by our results, and it does not matter how perfect the technique is, the results to the individual, (as Dr. Hawley says, the person who drives the machine) is the test. The papers represent admirable work. The paper, for instance, presented by Dr. Jones represents an attempt at team work which is in line with the idea given to us by Dr. Allison, in his paper last evening. It is a group of men, irrespective of what they call themselves, who, because of special fitness, are trying to accomplish certain end rseults. The thing that we must try to keep before us is sanity in the way we accept the work presented to us as a finished product by some experienced operator. For instance, I think the paper presented by Professor Putti yesterday was one of the most perfectly prepared and scientifical'y sound papers that I have ever heard; (applause) and yet I tremble to think of the harm that will probably follow the publication of that paper, as well as tragedies that will follow the publication of a paper like Dr. Hawley's, when it is read by a certain type of surgeon. I assume that Professor Putti thought the same thing; because three-fourths of his paper was devoted to the description of the selecting of the cases that were suitable for the operation. He then presented to you a most perfect technique, with results that were marvelously good. Dr. Hawley made a selection of cases also very carefully prepared and analyzed, and the results of ideal work; but it means that the selection of the cases was most carefully worked out. Otherwise, the results would not have been good.

We must look out lest we fail in this, and read only one part of the paper forgetting the three-fourths of the paper dealing with cautions. This is what we must do in our communications with the surgical groups, and make them read the three-fourths of Professor Putti's paper, as well as Dr. Hawley's article and the rest of the papers. Make them read the part that has to do with other things than the operation. Then, if they come to the operation, we shall have fewer tragedies than we will have otherwise. The very thing that Dr. Starr referred to in the part of the discussion that he closed last night, is the thing that we must not lose sight of. The best craftsmanship by the most carefully trained scientific mind, which thinks not only of the immediate operation—lots of people can do that,—but of the treatment in all of its details, with reference to the end-results.

That is what we must look out for. We have a marvelous lot of work, which should stimulate us to better work, but we must see that we thoroughly digest the work as it is presented, and do not see only some special phase of it.

DR. ORR, Lincoln, Neb.: Before discussing the papers that have just been read, I desire to pay my tribute of thanks to Sir Robert Jones for his many contributions to this meeting and particularly for his discussion of the subject, "Stiff Joints." I am sure we have all been greatly helped by what he has had to say on this subject.

In regard to the papers that have been read, one must, out of so much, select a few of the statements and discuss them only.

Dr. Goldthwait has dealt with some of the statements, it seems to me, quite too gently, and has even made the excuse that as he gets older he feels less strongly about some of these things. If, therefore, I treat some of the assertions that have been made somewhat more vigorously, I hope that you will not think that I am too young to have done so.

I desire to thank Dr. D. F. Jones for the presentation of his plans and work at the Massachusetts General Hospital. I feel that this is just the sort of thing that should be undertaken and developed, as one of the results of our war experiences. If better organization and more systematic methods can be evolved for the treatment of fractures, results are sure to be better also.

In Dr. Stone's paper, which Dr. Sever has kindly read for us, something is said about it having been found impossible in certain cases to obtain satisfactory position and firm union, so that operation was done and open treatment resorted to at the end of three weeks. In regard to such cases, I desire to make the suggestion that, if the securing of satisfactory position was impossible at the end of three weeks, it was probably also impossible at the end of three days. If open treatment is justifiable at all, it is usually justifiable and should be resorted to early. If, on the other hand, a competent and experienced surgeon sees such a patient early, it will often be found that replacement and immobilization are not only possible but quite sufficient in most cases. In other words, operation should not be resorted to on the say-so of a surgeon who is not duly qualified and thoroughly experienced in splint methods.

In the same connection, I wish to emphasize the point brought out by Sir Robert Jones, with regard to the manipulation of old fractures when this is necessary to readjust old malpositions. It is of the greatest importance not to use pump handle methods; a single intelligent movement is usually the only manipulation that is required. And when correction has once been accomplished, perfect immobilization should obtain from that moment.

With regard to Dr. Peckham's paper, one feels that it is, of course, permissible, or necessary, or even wise to allow an individual surgeon, who becomes an expert with a method which he has developed, to go ahead and use it with the patients under his care. I certainly think it is a mistake, however, for a surgeon who employs methods in which one or a number of fundamental principles are disregarded, to undertake to teach that method to others. In a meeting like this where any one of the members is quite competent to work out his own methods such teaching probably does no harm. If methods for the treatment of fractures, however, in which such an important factor as immobilization is not given sufficient consideration are taught to students or others without much experience in treatment of fractures, much harm may be done.

Dr. Henderson makes one statement to which I wish to take exception and in which I am inclined to accuse him of having copied from the text books. He says that "prolonged fixation makes stiff joints." It is my idea that this should be "prolonged imperfect fixation makes stiff joints." My idea is that ankylosis as well as the adhesion of soft parts about a joint is due to damage to those parts by infection or traumatism, or both. If these fractures are guarded by suitable immobilization, ankylosis and stiffness are reduced just to that extent. If, on the other hand, infection or traumatism are aggravated by constant motion, in or out of a splint, ultimate stiffening is just so much greater.

Dr. Hawley's paper invites criticism. He made a great many dogmatic statements, some of which even seemed to contradict themselves. Dr. Hawley's ability and achievements are too well known for any one to think that I would undertake to differ with him very seriously, except on points of detail. However, when he says that loss of function and disability do not go together, he is apparently discussing the matter from a purely theoretical rather than from a practical standpoint. Preservation of function as a means of securing function for a patient is one of the most important things that an orthopædic surgeon has to do, and as a rule, we find that impaired function and disability go hand in hand, and in almost exactly the same degree. He said also that there was no conflict between the mobilization of injured joints and the immobilization of fractures in the vicinity. Any one who has had experience in these, however, knows that the conflict between mobilization of joints and immobilization of fracture fragments nearby, real-

ly begins at the very moment of the beginning of treatment. And the difficulty of reconciling the mobilization of joints and the immobilization of fracture fragments really has been one of our most serious problems. When Dr. Hawley says later in his paper, that the more perfect immobilization is, the earlier is the return of function, he arrives at a conclusion with which I agree perfectly. I should feel very happy to have him adhere to the same principles in some of his statements regarding the splinting and other treatments of all other fractures and joint conditions.

DR. FRED H. ALBEE, New York City: I certainly was much pleased with this symposium, which is a very timely subject for the Association at this time.

With reference to Dr. Hawley's paper, I should like to make a few remarks. If I understand him rightly, he lays down two fundamental principles, which are general and complete in their application, namely, traction and leverage. I certainly would like to add one more, namely, the position of neutral muscle pull, or a position that will relieve the displacement effect of certain muscles upon the fracture fragments by employing a posture which relaxes the offending muscles. The principle of the Balkan frame is largely based on this very principle, traction being applied in a direction which causes the displaced muscles to be relaxed until they are no longer able to contract, or in other words to exert a displacing influence. The most common example that we have illustrating the application of this principle is that of a fracture below the lesser trochanter, when the limb is put up in flexion and abduction.

I cannot agree that traction and leverage are the two sole fundamental principles in the treatment of fractures. Great emphasis was placed by Dr. Hawley on the fact that form had nothing to do with function. Form has a great deal to do with proper function; and when we defeat form, the form given by the Creator, there is likely to be interference with function; and when we restore form, we favor function.

DR. JEFFERSON D. GRIFFITH, Kansas City, Mo.: I want to thank the gentlemen for their symposium, and should like to speak on the subject of fractures of the femur. We who are beyond sixty years of age ought to remember that we get a fracture of the neck of the femur very easily, for in the last twelve months I have had to treat five fractures of the femur in persons beyond sixty, and in all of them, in getting down the history, I found that in every case the fracture had occurred first, and then the fall. One has a little trip, and in trying to catch oneself the fracture occurs, and then the fall comes as the result of the fracture and not the fall and then the fracture. In persons beyond sixty, I think that if you get the history clearly, you will find that this is the case.

I think that Dr. Peckham's paper is awfully good. I tried to treat two of these cases with the Whitman abduction, but I got a little too much abduction in one. Then I tried to treat by Dr. Peckham's method, and the patient is doing very nicely now. I have had a photograph taken. I think that we can carry this abduction business too far. I just want to show the President, here, a picture that he can look through easily. Here is a case of abduction. You can see right through it, and it gives a perfect picture of abduction carried too far, in the hip of a child four years old. That is absolutely solid. This did not break of itself. I broke it. I made a little bit of incision. I was afraid to chisel that from above downward, after Dr. Jones's method; but I chiseled it from below upward, and that is the result. In this case, I speak of the lordosis. I want to speak of that, because the lordosis of that back was reduced from a circle of six inches, and now it is straight. The expression that the boy made use of when he came out is very good. He looked up and down, and said to the nurse, "Sister, that is the only time that I have seen my feet together."

The other case is one of adduction. The leg was across there. This young girl had never walked on anything but crutches since the age of three, and she

is nineteen years old. That leg was clear across and I cut it in the intratrochanteric line, bringing it in line. Now she is well and doing her own work.

Now, gentlemen, I just want to say one word further about the Osgood-Schlatter disease. I have been unfortunate enough to have had three of these cases in their adolescence. I offered to operate, and they all turned me down, so I had to find some other way. In taking pictures, I found in the youngest one, eight years old, that there was secondary ossification there. I did not know what to do with it, so I made a basket strap, with complete relaxation of the quadriceps extensor muscle, put it up so that she could not use that muscle, and got a cure.

DR. JAMES WARREN SEVER, Boston: I should like to show some lantern slides of the Osgood-Schlatter method, if I can show these for a moment. This is the case of a well developed boy of sixteen, very muscular. He was preparing for a high jump. As he got ready to make a spring, he felt something give way. In the first lantern slide, you can see that he pulled the entire tibial tubercle off the crest of the tibia extending into the knee-joint. The knee was tremendously swollen and ecchymotic. He was kept in a splint for ten days. Then we cut down on it and put in a mattress suture. Two months later, he had a perfect knee with normal motion. I had never known of the possibility that the insertion of that bone could be pulled off to such an extent. It was easy and simple to put back, and both legs show the same end condition. The other is the same as that which was injured.

DR. M. S. HENDERSON, Rochester, Minn.: I have nothing in particular to add. I agree with Doctor Orr in the main. However, I do not mean to imply that the stiffness which follows prolonged fixation is necessarily permanent nor is it an ankylosis. Nevertheless we do occasionally see cases where the limitation of the motion in the knee joint, for example, after a fracture of the femur is permanent, particularly in elderly people. What I have presented to you just now is really an abstract of the paper and in the full paper I tried to bring out the fact that this stiffness in the knee joint, which we only too frequently see in the prolonged fixation necessary in the Whitman method may be overcome by putting a joint in the cast at the knee. Every day the knee can be bent to a right angle, and fixation may be secured by putting a posterior splint along the cast.

DR. EDWIN W. RYERSON, Chicago: Dr. Orr's statement that the fracture is not immobilized, I wish to correct. It is immobilized while the mechanical treatment is being carried on.

DR. OSGOOD: You have been kind enough, gentlemen, to suggest that I could give an account of the disease that, in spite of me, has received my name. It is a case of misnomer. Dr. Goldthwait told me, when I was a struggling young practitioner, that I might work up his cases. This I did. I have never operated for this condition. The patients all get well with repeated adhesive plaster strapping. If they should prove resistent or if they were to be nuns or priests, I can conceive that it might be worth while to operate upon them so that they might not have an uncomfortable bunch to kneel upon, but our cases were relieved of stiffness by doing what Dr. Griffith says. I never thought of naming the disease after myself. It might be called sprain-fracture of the tubercle of the tibia. Some progressive Japanese, on looking up the literature of the condition, found that I had written first about it and named it after me. I want to protest against naming diseases after any man. It is a wrong method of naming diseases. A disease should be named for what it does on the basis of its pathology, or something of that kind.

News Notes

PROGRAMME FOR THE BRITISH ORTHOPÆDIC ASSOCIATION MEETING, Shropshire Orthopædic Hospital, Oswestry, September twenty-fourth and twenty-fifth, 1921:

Saturday, Sept. 24th.

9.30 A.M. Executive proceedings of the Association.

10.30 A.M. Visitors to be shown around Hospital by the Staff.
Out-patient Clinic by Sir Robert Jones.
Demonstration of treatment of calcaneo cavus with cases, casts and x-rays, by Mr. Naughton Dunn.
Demonstration of plaster work by Mr. Aitken in the plaster room.
Talk on bone-grafting for tuberculosis of the spine in children, with cases, by Mr. Girdlestone.
Mr. Girdlestone.
Ward visit. Mr. Noble.
Demonstration of exercises in the gymnasium.

1.00 P.M. Lunch (at the hospital).

1.45 P.M. Visit to AFTER-CARE CENTRES.
Party No. 1 Shrewsbury
Party No. 2 Oswestry
Party No. 3 Wellington

7.30 P.M. Dinner at the Wynnstay Hotel, Oswestry.

Sunday, Sept. 25th.

10.30 A.M. Operations by the Hon. Staff:
(Operations as cases permit.)
1 Sir Robert Jones
2 Mr. Girdlestone
3 Mr. Aitken
4 Mr. Dunn

1.00 P.M. (onward). Lunch (at the Hospital).

THE EASTERN STATES ORTHOPAEDIC CLUB will meet in Baltimore November fourth and fifth.

Current Orthopaedic Literature

BILATERAL FORWARD DISLOCATION OF THE FIFTH CERVICAL VERTEBRA WITH REDUCTION BY MANIPULATION. Mitchell Langworthy. *Journal A. M. A.*, Feb. 12, 1921, p. 447.

Case of a man of 28 years in an automobile accident, head and neck being bent forward. X-ray showed, in lateral view only, a bilateral forward dislocation of the fifth cervical on the sixth, with slight impaction of the body of the fifth. Symptoms were priapism, numbness and tingling in the right hand and forearm and over the entire left lower limb. Frequent coughing with some fresh blood in the sputum. Knee jerks seemed normal. There was no motor paralysis and no gross eye findings. Respiration was difficult.

Reduction under an anesthetic by the method of Walton was accomplished. When the reduction was accomplished a dull bump was felt and no snap or click. Movements of the neck immediately became free in all directions.

The symptoms entirely disappeared so that on the fourth day the patient was allowed up in a plaster cast which supported the weight of the head on the shoulders.

Ten weeks after injury patient had no symptoms except some soreness and stiffness in the region of the ligamentum nuchae and trapezius muscle at the base of the neck.—*Lloyd T. Brown, Boston, Mass.*

LESIONS OF KNEE IN EX-SOLDIERS. F. J. Cotton, M.D., *Military Surgeon*, July, 1921.

Fifteen cases in all came to the operating room. These were in part cases of torn and displaced semilunar cartilages, but there were four cases of definite osteochondritis dessicans which proved to be of interest. Two cases had only adhesions following contracture, both from gunshot wounds, both stretched under ether, neither of particular interest save that intervention produced results according to a method perhaps not followed as consistently as it should be.

This method rests on the fact that, while "brisement forcé," the rough breaking up of adhesions, whether within or near a joint, fails of its object in the end, from the excessive reaction and the unavoidable aftertime of soreness that gives fresh stiffening, yet in the course of physiotherapy and gentle stretching under an anæsthetic, carry the range of motion just beyond this dead centre without entailing much soreness afterward, some adhesions may give

way but what we do in the main is to stretch taut tissues. A few days of soreness, mitigated by cautious massage, bring us back to the routine of limbering the joint gradually through a further arc.

"Brisement forcé" is out of date.

The author's way of handling loose, traumatic joints is to excise hypermobile semilunar cartilages, trim ruptured crucial ligaments, remove strip of fascia lata about three-fourths of an inch wide from the thigh. From the posterior lateral surface of the internal condyle, this fascia lata strip was inserted through drill holes and lashed, stitched, and fixed. This was stretched down anteriorly where it was attached in a similar manner to the anterior lateral surface of the tibial tuberosity, forming an artificial internal lateral ligament stretched over the healed but lax original ligament.

In the half dozen cases in which the author has done this operation results have been very satisfactory with no lax joints after operation, and he regards this as the operation of choice in the type called ruptured crucials, in which the joint has loose motion laterally as well as antero-posteriorly. The operative procedure does not repair the crucials, but it does stabilize the knee.

The series of cases of osteochondritis dessicans brings up two points: First, the nature of it; second, the frequency of secondary change from operation long delayed in cases of pure (or nearly pure) mechanical trouble in the knee. As to the author's four cases, one (Case 12) might be due to bodies grown from chipped off osteophytes, for there was an arthritis and there was no defect to account for the origin of the loose bodies.

Case 14 does for Ludloff's theory because the external condyle was affected.

Cases 12 and 15 both showed defects so far back and within the notch as to preclude any possibility even of direct trauma.

Cases 12, 13, 14 had definite bodies within the crucials, with untorn crucials, with bodies not in contact with bone (disposing of any theory of avulsion by ligament).

Cases 13 and 14 showed a distinct dissecting process, in one case leaving a vascular, in the other an avascular base and both showed excentric growth of the separated portion.

The second point in question is that of operative interference in general and of technique.

No one is likely to dispute the wisdom of taking out foreign bodies or torn, displaced semilunar cartilages, etc.

"The real point illustrated," the author thinks, "by this series is the frequency of secondary changes in lesions essentially mechanical of a variety of kinds." The author believes it fair to infer that "all kinds of mechanical defects in the knee-joint, neglected, may lead to secondary changes in the joint, changes that will not resolve themselves to normal, even with the irritant gone." —*J. M. Foley, Washington.*

MECHANICAL INFLUENCES IN SCIATICA. E. W. Fiske, *Pennsylvania Medical Journal*, June, 1921.

Inadequacy of its treatment. Undoubtedly the chief reason for the confusion lies in the usual methods of presenting the condition in medical teaching. It

is found in textbooks of general medicine and neurology as an entity, but little is made of it in works of surgery. As long as sciatic neuritis is considered a distinct disease and so treated, just so long will the underlying causes of this neuritis be neglected, with obvious failure of relief.

The secondary nature of sciatica is becoming more generally recognized. "Sciatica," as commonly used, does not differentiate between a neuritis and a neuralgia.

In twenty consecutive cases of sciatica which came under the author's observation in the past year, not one has failed to reveal an apparent primary cause in the low back. Three of these cases, representative of the group, are reported in detail.

The diagnosis made in twenty cases was sciatica secondary to sacroiliac strain in 55%, to lumbosacral lesion in 25%, to muscular back strain and myositis in 15%, and to possible bone infection in 10%.

Symptoms, according to percentages, in the twenty cases are reported in detail. Mention is made of possible bone anomaly as revealed by the x-ray in 15%.

The treatment was manipulation followed by fixation in 40%, fixation only in 60%. Of the cases manipulated, recovery occurred in 50%, of the fixation cases in 47% (17).

The author believes that in the majority of cases there is pressure by infiltration about the lumbosacral plexus as it crosses the sacroiliac joint. There may also be a reflex from an affected joint.

While we are still in the dark as to the effects and results of manipulation, the author advocates orthopædic examination in all cases of sciatica and orthopædic treatment where such mechanical causes are found.—*J. M. Foley, Washington.*

PAGET'S DISEASE OF THE BONES WITH POSITIVE WASSERMANN REACTION. Vallery-Radot, Stevenin and Fatou. *Bull. de la Soc. Méd. des Hóp. de Paris*, March 11, 1921.

Referring to the contention of Mentrier, Dufour and others that an argument in favor of the syphilitic origin of this condition is furnished by amelioration of pain following anti-syphilitic treatment, the authors present a case in point. All the characteristic features of an extensive and well-developed Paget's disease appear to have been present in this case. There was no history of syphilis, nor were any signs or stigmata found; but the blood Wassermann reaction was positive, and pupillary light-reflexes were lost. Mixed mercurial and arsenical treatment was followed by a decided relief from pain, which had previously been a marked and progressive feature. No claim is made by the authors that their case constitutes a confirmation of the theory that Paget's disease is of syphilitic origin. Reference is made to collective reports of 30 cases of Paget's disease in which the Wassermann test had been applied; seven were positive; twenty-three were negative.—*Roades Fayerweather*, Baltimore.

DIAGNOSIS OF POST-TYPHOID BONE AND JOINT DISEASE. P. Emile-Weil. *Bull. de la Soc. Méd. des Hôp. de Paris*, April 8, 1921.

Confirming the reports of Dufour and Sicard of the positive value of vaccine-therapy in these cases. Emile-Weil describes his own procedure, emphasizing the following points: (1) Of the various types of organisms, Eberth's bacillus is that chiefly capable of producing bone lesions; (2) before effective vaccine therapy can be instituted the type must be established; (3) especially must the lesion be distinguished from tuberculous disease; (4) both for establishing the type and for distinguishing typhoid from other chronic bone diseases the agglutination test is reliable, even after considerable lapse of time, or when anti-typhoid innoculation has been given. A portion of the article is taken up with statements in support of this last point. In discussing this communication, Dufour states that from a practical point a polyvalent vaccine from typhoid and paratyphoid organisms gives excellent results.—*Roades Fayerweather, Baltimore.*

CURE OF TYPHOID SPONDYLITIS BY VACCINE THERAPY. H. Dufour, Debray and Guyard. *Bull. de la. Soc. Méd. des Hôp. de Paris*, March 11, 1921.

A fourth case is added to three previously reported as successful. Symptoms appeared in region of second lumbar vertebra three months after onset of typhoid fever, and had resisted other methods of treatment. Serum agglutinated bacilli of Eberth's type 1/150. Vincent's vaccine of three types mixed was given: initial dose of ½ cc.; after four days, 1 cc.; nine days later, 1½ cc.; latter dose twice repeated at ten-day intervals. Pain and fever were controlled after the early treatments.—*Roades Fayerweather, Baltimore.*

HEMORRHAGIC OSTEOMYELITIS OF FEMUR. P. G. Lacroix, *New Orleans Med. and Surg. Journal*, April, 1921.

One case of hemorrhagic osteomyelitis of femur is reported of the lower part of left femur. Tumor removed and wound on each side of the knee closed by Willems method.

Immediate active mobilization gave good result and patient resumed his work four months after operation, using a caliper brace.—*Edward S. Hatch, New Orleans, Louisiana.*

RUPTURE OF TENDON OF INSERTION OF THE BICEPS FLEXOR CUBITI. John Joseph Nutt. *Journal A. M. A.*, June 25, 1921, p. 1825.

One case is reported in which the tendon was ruptured while patient was exercising on flying rings. Operation two days later, torn ends sutured with chromic catgut. Result excellent. Literature shows 65 cases.—*Edward S. Hatch, M.D., New Orleans, Louisiana.*

NONOPERATIVE TREATMENT OF FRACTURES OF CERVICAL VERTEBRAE WITH CORD INJURY. THE RESULT IN FOUR CASES. Michael Osnoto. *Journal A. M. A.*, June 18, 1921, p. 1737.

The problem as to whether a case of cervical cord injury should be operated on or not is a delicate one. Elsberg says that operative interference in a complete transverse crushing of the cord is useless, but an operation may be necessary if there is no complete transverse lesion. The dangers of operating on the cervical cord are œdema and consequent interference with the functions of the vagus and phrenic nerves.

Four cases are reported. The first one was probably a complete crush of the cervical cord and the patient died. The other three recovered. It is probable that a greater mortality would have resulted with operation.—*Edward S. Hatch, M.D., New Orleans, Louisiana.*

THE SURGICAL ASPECTS OF INJURIES OF THE BRACHIAL PLEXUS. Alfred W. Adson. *N. Y. State Journal of Med.*, Sept., 1921, p. 331.

This article is based on a study of 101 cases of brachial plexus injury recorded in the Mayo Clinic since 1910.

Of these 45 were birth palsies, and in all but five there was a history of difficult or operative delivery. Shoulder dislocation was found present in 13 cases. The incidence of this condition was much greater in the age group above two years than in that below, from which he argues that Thomas' theory of shoulder dislocation with laceration of the capsule and resultant axillary inflammation as the etiology of the lesion is not borne out. He concludes that it occurs as a consequence of paralysis. Treatment of the condition was attended by great improvement in function, the greatest improvement occurring in those below the age of two. He does not describe the treatment used.

Fifty-six cases of traumatic brachial paralysis were studied. These were produced by trauma to the shoulder and neck without fracture, 23; by trauma associated with fracture or dislocation of the clavicle or humerus, 12; by belt injuries, 13; by gunshot or stab wounds, 8. Twenty-five were operated and in those where the brachial plexus was explored the findings were usually laceration of the nerve roots close to the intervertebral canal with such wide involvement in scar tissue that it was only rarely possible to resect and anastomose. Fourteen of the 25 operations were failures, 11 were improved to approximately 40% function; 32 patients were not operated upon but treated medically; four were failures, 26 had 45% return of function. Failure resulted in 58% of the operated cases, and in 15% of the unoperated cases.

Adson presents a preliminary report on experimental tears of the brachial plexus produced on the cadaver. He concludes that while production of complete laceration or avulsion is difficult, it is possible, and depending on how the force is applied may affect either the upper or lower part of the plexus with avulsion of the sympathetic ganglion. Owing to the proximity of such injuries to the intervertebral canal, repair is difficult. Many of the brachial plexus palsies are the result of lacerations of the cervical fascia, epineurium,

perineurium, fasciculi and blood vessels rather than of complete laceration or avulsion.—*P. D. Wilson, Boston, Mass.*

Is Sciatica a Symptom or a Clinical Entity? William J. Leszynsky, *N. Y. State Jour. of Med.*, Sept., 1921, p. 337.

The author argues from his own experience with a large number of patients that sciatica is a clinical entity in about 75% of all cases and that only in the remaining 25% it is secondary to affections of the lumbosacral, sacroiliac and hip articulations or intrapelvic troubles.

For treatment of the condition he advocates rest in bed, with thorough emptying of the lower bowel and application of heat and sedatives. In severe cases hot saline rectal irrigations, followed by suppositories of opium and belladonna.

He has used with success perineural injections of salt solution, but finds that the injection must often be repeated several times before relief is obtained. He has used injection of saline solution, with or without novocaine, into the sacral canal in about 50 cases and finds it invaluable for the treatment of subacute or chronic cases. It is the most effective agent he knows.—*P. D. Wilson, Boston, Mass.*